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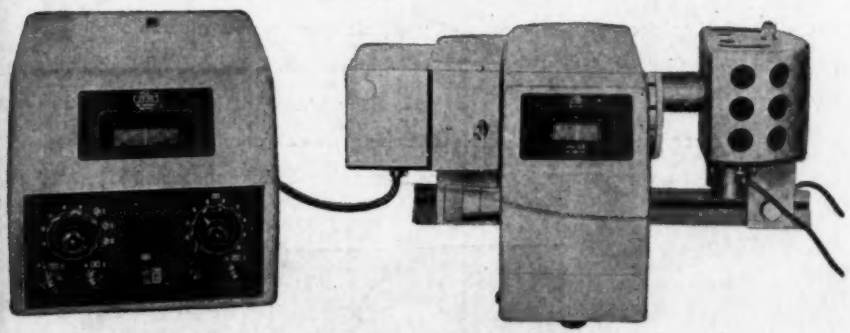

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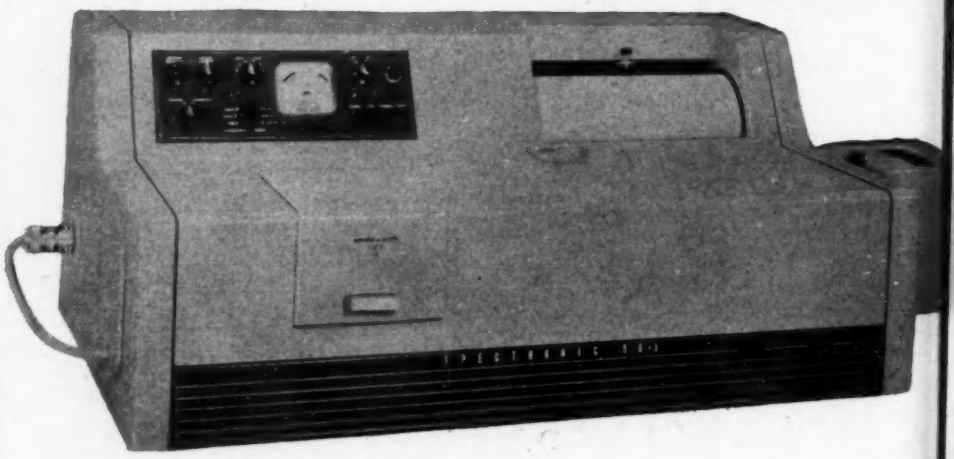

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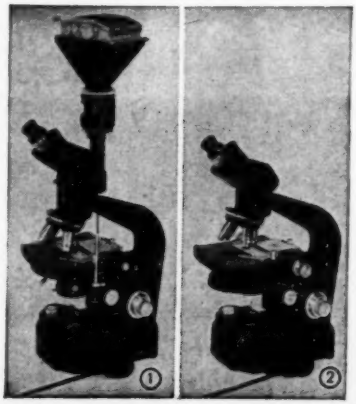

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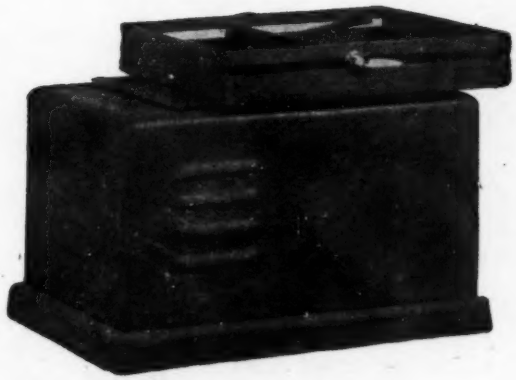

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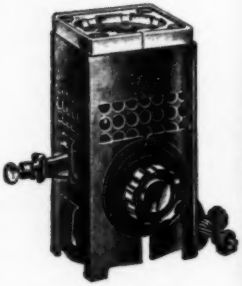

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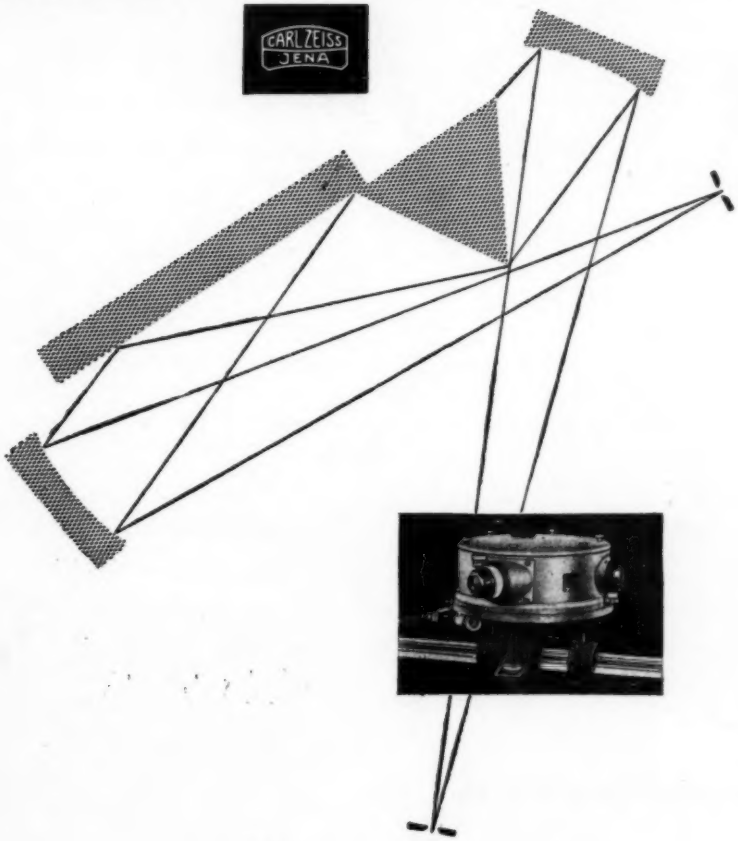

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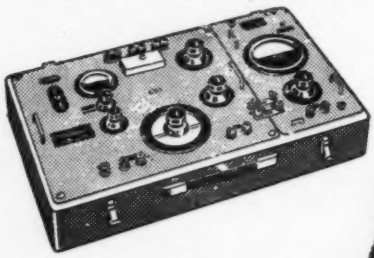

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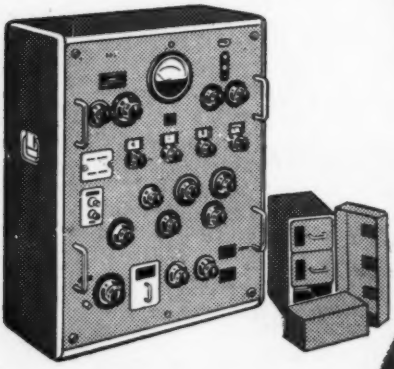

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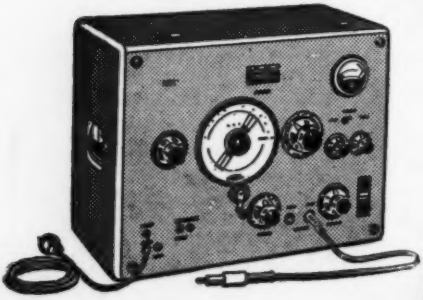

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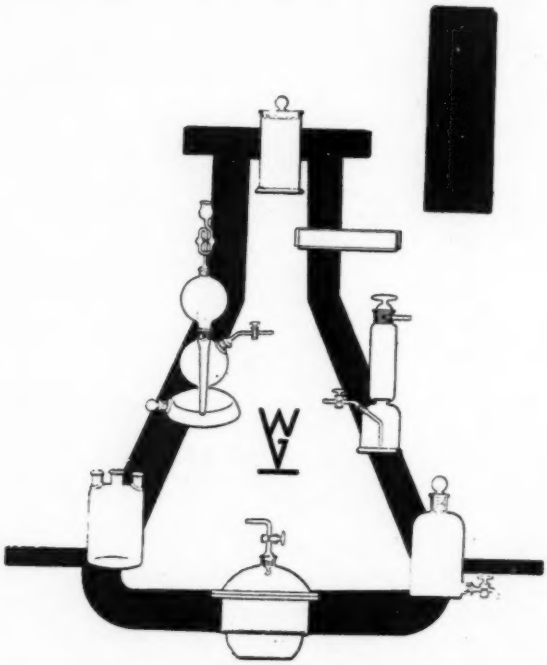

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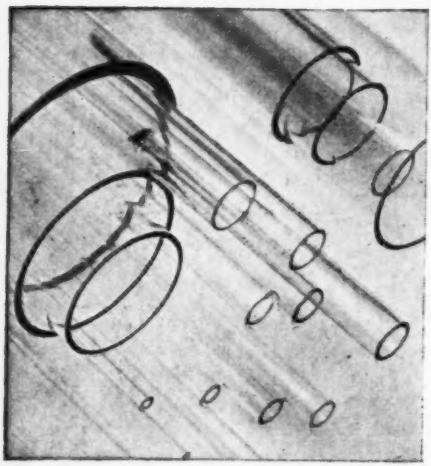

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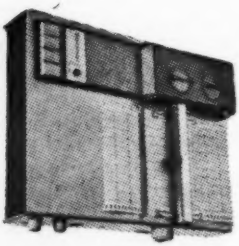

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COHERENCE PROPERTIES OF ELECTROMAGNETIC RADIATION

PART II

S. PANCHARATNAM

Resonance Radiation and Induced Emission

TOWARDS the beginning of this century, R. W. Wood discovered the phenomenon of esonance radiation in sodium vapour: when e monochromatic yellow light of sodium was ssed through sodium vapour, the latter in turn hibited a yellow fluorescence of the same aracter, the incident radiation being rapidly sorbed on passing through the vapour. The rm resonant fluorescence or resonance radiation describe the emitted light arose from the assical explanation of the phenomenon, which is worthwhile to outline in some detail—since gives correctly the coherence properties of e secondary radiation which we shall require later sections.

When a plane wave of light traverses a edium composed of classical dipole-oscillators e latter will be set into forced oscillation at e frequency ν of the incident wave. Because the periodic dipole thus induced each atomic cillator will emit radiation of the incident equency ν—which may be observed as a feeble yleigh scattering transverse to the beam. How-er, when the frequency of the incident light ncides with the natural frequency ν_0 of the pole-oscillators, the amplitude of the forced cillation (and consequently the intensity of e secondary scattered radiation) should build to large values because of the phenomenon resonance. It must be noted that the induced pole-oscillation will have a specific phase-ationship with the exciting light field mounting to a phase lag of $\pi/2$ at exact onance). Thus in turn the resonance radia-n from an atom should be *coherent* with the citing radiation. This explains at once the parent absence of secondary radiation in the act forward direction, *i.e.*, in the exact direc-n of the exciting beam, and the attenuation absorption of the latter. For, it may be wn that all the secondary wavelets from a ne of atoms normal to the incident beam will lesce to form a plane wave travelling in the e direction as the incident beam, but exactly posed in phase to it. Thus, it is really the tructive interference of the resonance radia-n scattered in the forward direction with the ident beam that leads to the progressive enuation of the latter.

On the quantum theory, resonant fluorescence es because the incident photons are of the right energy to raise the atoms from the normal or ground state to a higher energy state, the atom then returning to the initial state with the emission of resonance radiation. The coherence of the emitted radiation with the incident, however, indicates that the two transitions, *viz.*, to the higher energy state and back, must not be regarded as independent processes, but as part of a composite process. If we treat radiation alone classically, we may say that the oscillating dipole moment (corresponding to the double-transition) lags in phase by $\pi/2$ behind the phase of the perturbing light wave—as also happens when the atom, too, is regarded as a classical oscillator.

We have considered the atom to be initially in the lower state but the quantum picture naturally leads us to ask the following question: Could we also expect a form of resonant fluorescence when the atom is initially in the upper or excited state, and the energy of the incident photons coincides with the energy difference between the initial state and a *lower* energy state of the atom? The answer is yes, but the phenomenon is termed *induced* emission to emphasize that this radiation is induced by the presence of the light field, and thus represents something distinct from spontaneous emission: the latter is due to the natural decay of the excited atom from the upper to the lower state and would continue to exist even in the absence of an external light field. Induced emission is usually described as a transition from the initial excited state to a lower energy state under the influence of radiation of the appropriate resonant frequency, *i.e.*, which lies within the natural line-width. However, in the author's opinion it should perhaps be considered—as in the analogous case of resonant fluorescence—as involving a double-transition, *viz.*, to a lower energy state and back. As in the case of resonant fluorescence, the radiation from an atom due to induced emission is coherent with the light wave which stimulates it. However, an important difference in the present case is that the phase of the oscillating dipole-moment (corresponding to the double-transition of the atom) is advanced by π relative to that obtaining in normal resonant fluorescence. Thus, if we have an assembly of atoms which are—by artificial means—being kept in an excited state, then when a plane

wave of light of the appropriate resonant frequency is incident, the stimulated emission from the atoms will, in the forward direction, interfere with the original beam actually to *amplify* it—rather than to attenuate it as in the normal case of resonant fluorescence.

Such amplification has already been realised in the corresponding case of *microwaves* using the device known as the maser (see *Current Science*, 1958, Vol. 27, p. 117). But for an *optical* transition the difference between the energies of the upper and lower states is comparatively large, so that the problem of artificially maintaining a preponderance of atoms in an optically excited state is a difficult one. However, very recently, effects depending on *light amplification by stimulated emission of radiation* ('LASER' action) have been observed experimentally. We shall, in the last section, return to these experiments—which must certainly be classed among the most spectacular and fundamental experimental observations in the field of optics in recent times. Before, however, turning to stimulated emission, it would be appropriate first to deal with certain recent beautiful experiments involving resonant fluorescence which are relevant to the subject of this article.

2. Interference Effects in Crossed Hyperfine Levels

Consider an atom with two upper energy levels separated by a small value. When irradiated with suitable radiation whose line-width is larger than this term-separation, resonance radiation of two frequencies will be emitted —corresponding respectively to transitions from the two upper levels to the ground state. The intensity of the resonance radiation will be the sum of the intensities of the radiations due to each transition, separately. If now, by the application of a magnetic field, the two upper levels are split into Zeeman components, the intensity of the emitted resonance radiation would, *in general*, be unaffected. However, suppose the magnetic field has a particular value such that a Zeeman sub-level of one state coincides in energy with a sub-level of the second state. Then the resonance radiations (now of identical frequency) emitted by transitions from these (coincident) sub-levels to the ground state will be coherent and in phase with one another—since both radiations should be coherent with the spectral component of the incident light responsible for exciting them. Therefore, the intensity of the resonance radiation of the frequency in question will be given by squaring the sum of the *amplitudes* of the radiations due to each transition separately, and will thus be greater than the sum of the intensities due to the separate transitions. The increase in intensity of the resonance radiation will also manifest itself as an increased attenuation of the incident beam—since the latter phenomenon, as we have explained in Section 1, is due to the destructive interference of the resonance radiation with the original beam, in the forward direction. Thus by sweeping the magnetic field and looking for increased absorption of the exciting beam, one can determine the magnetic field strengths at which the energies of two sub-levels cross each other—this in turn giving spectroscopic information regarding the atoms. The use of such a phenomenon was described by P. A. Franken at the Conference on Coherence in a paper the title of which forms the heading to this section. Franken gave a mathematical analysis of the phenomenon from the quantum theoretical standpoint, different from the physical explanation given above by the author.

3. Light Beats in Coherent Scattering

We have mentioned above that the resonance radiations emitted by the decay of atoms from two excited states of different energies are of different mean frequencies and incoherent with one another. However, suppose an atom which is initially excited to one or other of the states is subjected to a radio-frequency field which induces transitions to the other state; then the atom may be described as being in a quantum-mechanical state which is a coherent superposition of the two states. In the subsequent decay to the ground state the radiations of the two frequencies could be expected to be coherent with one another and thus give rise to light beats. G. W. Series in the Conference at Rochester described beautiful experiments in which such a periodic modulation of the intensity of the 2,537 Å resonance radiation emitted by mercury vapour had been actually observed. The vapour is kept in a magnetic field so that the 6^3P_1 level of mercury (decay from which gives 2,537 Å radiation) is split into three closely spaced levels ($m_j = 1, 0, -1$) separated by equal intervals $h\nu$. A second magnetic field in a perpendicular direction oscillating at a radio-frequency ν_0 near ν, 'mixes' the states. The photoelectric current recording the intensity of the fluorescent radiation emitted under irradiation is applied to a narrow-band amplifier tuned to ν_0, or $2\nu_0$. Light beats at the latter frequencies were thus directly detected by suitably choosing the direction of observation—the cases when the beats were absent being readily explicable as due to

orthogonal polarisation of the two interfering radiations.

The comparative ease with which beats were observed in the above experiments is to be contrasted with the great difficulty with which beats between the Zeeman components of a spectral line were directly detected by Forrester *et al.* (see Part I). In this context, it was pointed out by the author that it becomes meaningful even when considering two quasi-monochromatic beams whose mean frequencies *differ* by some value ν, to talk of the coherence or otherwise of the beams—with reference to their capability to produce a beat of frequency ν. Considering the finite spectral width of each beam, each Fourier component of one beam may be paired with a corresponding Fourier component of the second beam, such that the spectral separation of the pair is ν. While the mutual interference of every such pair gives rise to a beat of the same frequency ν, the *phases* of the beats due to the different pairs are also identical in the case of the experiments of Series *et al.*, but not so in Forrester's experiment. This feature is vividly underlined by the remarkable fact that in the experiments of Series *et al.*, the separation in the mean frequencies of the two radiations, which may be regarded as interfering, is very much smaller than the spectral width of each radiation.

The theoretical explanation given above for the experiments of Series *et al.* represents their original view-point as outlined very briefly in their note[1] first reporting their observation of the intensity modulation of fluorescent radiation. A feature of such an interpretation to which it seems worthwhile to draw attention is the indirect bearing it has regarding the properties of the (complex) ψ function representing the quantum-mechanical state of an atom. While normally only $|\psi|^2$, the square of the modulus, is regarded as having any physical significance, it would appear now possible to manipulate experimentally the relative *phases* of the ψ functions of the various states—these determining in turn the phase of the radiation emitted. It must be remembered that the above holds when the radiation field is treated *classically*, as is often done. However, in the Conference, Series showed that a detailed mathematical treatment in which the radiation field is quantised (following Dirac) leads directly to a periodic variation in the probability of photon emission—interpreted previously as beats.

R.F. Modulation of Resonance Absorption

In 'double-resonance' experiments of the type discussed above, a modulation of the resonance absorption of the exciting beam is to be expected due to its interference or 'beating' with the resonance radiations emitted in the exact forward direction. Such an effect had been observed in the resonance absorption due to sodium vapour by Bell and Bloom,[2] and the latter reported on experiments of this type. The phenomenon depended on the 'mixing' of the two *ground* state Zeeman sub-levels by an r.f. field of the resonant frequency. But this had to be done after first getting all the atoms into *one* of these Zeeman sub-levels, *e.g.*, that for which the angular momentum vector ($J = \frac{1}{2}$) points along the direction of the magnetic field rather than against it. This was achieved by a process known as optical pumping. Modulation of optical absorption at the Larmor frequency was now observed in a circularly polarised beam transverse to the magnetic field. The experiments of Bloom *et al.*, followed a suggestion by Dehmelt,[3] and in fact their interpretation of the phenomenon is of quite a different nature, i.e., *not* as a beat phenomenon.

5. Laser Action in Ruby

In any normal monochromatic source of light the different atoms radiate incoherently. But certain recent remarkable experiments from the Bell Telephone Laboratories[4] report what is in principle a highly monochromatic source of very large specific intensity in which all the atoms radiate coherently with one another; furthermore the radiations from the different atoms interfere constructively only along one particular direction, so that the emitted energy automatically forms a well-directed beam instead of spreading out in all directions.

The radiation in question is the well-known red fluorescent light (6,943 Å) emitted by the chromium ions in ruby. A cylindrical rod of ruby a few inches long—with the end faces optically plane-parallel and semi-silvered—was used. It was irradiated through all sides of the cylindrical surface by keeping the rod within a suitable flashlamp operated by a pulse-discharge, the fluorescent emission excited by the irradiation being examined. Under normal conditions of irradiation the fluorescent radiation from different atoms are mutually incoherent and the emission proceeds along all directions. But when the level of irradiation was gradually increased to very large values (so that the energy discharged through the lamp was of the order of 2,000 joules) the state of affairs was found to alter very suddenly. The fluorescent radiation was then found to emerge normally from the end faces as a plane parallel beam with a divergence of less than a degree.

The light as seen through the silvered ends went up by about three *orders* of magnitude. The spectral half-width of the 6,943 Å emission narrowed to one-thirtieth of its normal value. These experiments confirmed and extended the evidence of such behaviour first reported by Maiman.

By the absorption of light in the green portion of the spectrum the chromium ions in ruby are raised to a higher state from which they decay—practically instantaneously, for our present purposes—to an excited state ^2E; and it is the transition from this excited state back to the ground state that is accompanied by the well-known red fluorescent emission. Under normal conditions of irradiation the number of atoms in the excited state ^2E will of course be very much less than in the ground state. But by increasing the intensity of irradiation, the population in the ground state can be depleted, so that actually more atoms are in the excited state. When the population inversion becomes sufficiently pronounced, the course of events become rapidly dominated by the effects due to induced emission (Section 1), and consequent coherent self-amplification of the fluorescent radiation in the ruby. One may say that each chromium ion is so engulfed by the fluorescent radiation due to the others that each ion tends to emit radiation in phase-relationship with the rest. The mutual phase-relationships which actually result in the present case is such that the resultant radiation is directed as a parallel beam along the axis. That this 'mode' of coherent emission of the assembly of ions gets 'preferred'—to the exclusion of others which o can conceive of—is due to the plane-paral and semi-silvered ends of the cylinder. F example, a ray appreciably inclined to the a would leave the system after a few reflection while a ray nearly parallel to the axis ge reflected back and forth, getting progressivel amplified all the while (due to the populati inversion in the medium).

The enormous sharpening of the spectral lin width of the fluorescent emission arises mainl because the frequencies near the centre of t 'natural' line-width are more effective in stim lating emission than the rest, and are conse quently amplified to a greater extent. T effect is in a sense the converse of the tendenc towards self-reversal near the centre of t spectral line, observed under normal condition where effects due to induced absorption pr dominate. The fact, that energy absorbed ov a wide range in the green part of the spectru is compressed to within a spectral range $0{\cdot}2\ \text{cm.}^{-1}$, also contributes to the enormo specific intensity. In terms of a black-bod emitting the same spectral density of radiatio the effective temperature of the source corre ponds to 10^{10} degrees kelvin!

1. Dodd, J. N., Fox, W. N., Series, G. W. a Taylor, M. J., *Proc. Phys. Soc.*, 1959, **74**, 78
2. Bell W. E. and Bloom, A. L., *Phys. Rev.*, 19 **107**, 1559.
3. Dehmelt, H. G., *Ibid.*, 1957, **105**, 1924.
4. Collins, R. J., Nelson, D. F., Schawlow, A. L Bond, W., Garret, C. G. B. and Kaiser, W *Phys. Rev. Letters*, 1960, **5**, 303.

TWO-QUANTUM TRANSITIONS IN ELECTRON PARAMAGNETIC RESONANCE

BURGET *et al.*, of the Institute of Nuclear Research, Prague, report cases of two-quantum transitions in Electron Paramagnetic Resonance (EPR) spectra. The essence of two-quantum transitions consists in the simultaneous absorption of two energetically different photons or in the simultaneous absorption of one photon and the emission of another photon having a different energy (Raman process), on the assumption that the condition of the conservation of energy and the angular momentum is preserved for the system in which this transition occurs. If we apply to a system of electron spins two high-frequency fields $H_1 \cos \omega_1 t$ and $H_2 \cos \omega_2 t$, where the first is parallel to the external static field H_0 and the second is perpendicular to it, the simultaneous absorption or absorption and emission of two kinds of photons $\hbar\omega_2$ (σ photons) and $\hbar\omega_1$ (π photons) may tak place if it holds that $\hbar\omega_2 \pm \hbar\omega_1 = g\beta H_0$.

The case of emission is particularly importa since the mechanism can be used to realize maser in a system with a positive temperatur while all other types of masers are based o the creation of negative temperatures in t spin system.

The apparatus used for observing these tra sitions consisted of an EPR spectrometer, wor ing on a frequency $\nu_2 = 8500\ \text{MH}_z$, and autodyne spectrometer for NMR, working o frequency $\nu_1 = 13\ \text{MH}_z$. The autodyne spectr meter simultaneously served as a generator frequency ω_1 and as a detector of two-quant transitions. The small coil of the autody spectrometer containing the sample, was locat directly in the resonance cavity of the E spectrometer.—(*Czech. J. Phys.*, 1960, 10, 5

NATURAL PURIFICATION OF FLOWING SEWAGE

S. C. PILLAI, G. J. MOHANRAO, A. V. S. PRABHAKARA RAO, C. A. SASTRY AND P. V. R. SUBRAHMANYAM
Department of Biochemistry, Indian Institute of Science, Bangalore
AND
C. V. NATARAJAN
Formerly Deputy Director, Department of Public Health, Bangalore

[This article embodies observations made over a period of a decade and throws light on some of the fundamental principles of sanitation. The article would, therefore, be of interest to sanitary authorities throughout the world, although the set of conditions, which revealed those principles, have been provided by the peculiar method of sewage disposal particularly at Bangalore.

It also happens that almost exactly 100 years ago, a similar but empirical observation on natural purification of flowing sewage was made in England. That was, of course, before the days of our knowledge of any microbial activity which is now known to be the most important factor governing environmental sanitation and hygiene.]

Introduction

In the course of the discussion of a paper "On the application of town sewage to a large agricultural area, comparing its strength and dilution with the ordinary farm manurial resources; with considerations of its effects on farm profit" read before the Royal Society of Arts on March 7, 1860, one of the members of the audience, P. H. Holland, remarked: "He would in conclusion only allude to the fallacy which Mr. Sidney had put forth upon the authority of Mr. Hawksley. That gentleman, an engineer, had put forward a notion which must be astounding to every chemist. It was this, that if sewage ran away for a distance of about 10 miles, it was no longer sewage, but almost plain water. That was one of the most astounding assertions he had ever heard made".[1] Except this rather empirical statement about the behaviour of flowing sewage, which was discussed presumably against the background of the prevailing ideas of the changes in soil and sewage, there is practically no information on the natural purification of sewage in the literature. The object of this communication is to give a brief account of the conditions, particularly at Bangalore, under which some 16 million gallons of sewage now daily flows down on the outskirts of the town and purifies itself naturally without any treatment, and to indicate the operation of a principle of sanitation as evident from continued observations over a period of about ten years.

Conditions at Bangalore

Bangalore is an inland town situated on the Deccan Plateau at a height of about 3,000 feet above sea-level, having an average annual rainfall of 33·3 inches, most of which occurring during May to October. The maximum temperature reached on individual days during the warmest months of April and May is 102·4° F. and the minimum temperature touched on individual days during the coolest months of December and January is 46° F. The rapidly growing town of Bangalore has now a population of about 1·4 million people and its present daily water consumption is about 17 million gallons. The water-supply is derived mostly from the Arkavati River about 22 miles west of Bangalore.

Most areas of Bangalore are provided with underground sewerage system. The bulk of the sewage is taken to three outfalls at the suburbs of the town, two of these sewage outfalls being on the southern side and the third outfall being on the south-eastern side of the town. From these outfalls the sewage is allowed to flow down in three natural channels having varying gradient, *viz.*, 1-in-50, 1-in-100 and 1-in-800. The land surface in and around Bangalore has unusual depressions and elevations, and this topographical feature has apparently been utilised for the disposal of the town sewage since the early days of the introduction of the sewerage system in 1922.

There is no river or stream near the sewage outfalls or around the channels taking the sewage. At the various points along these channels the sewage is drawn by the farmers in the neighbourhood (over 500 families) for irrigating the land and raising crops, such as vegetables and fruits, including occasionally sugarcane and rice. There is no organised system of sewage irrigation; the farmers

inprovise their own methods for taking out the sewage from the channels, when necessary.

Investigations at Bangalore

It has been observed that the turbid, foul liquid flowing in these channels becomes clear and is oxidised to an appreciable extent after its flow over a distance generally of 1 to 5 miles, depending on the gradient of the channel, and the purified effluent is used by the villagers in the vicinity for washing purposes.[2] In view of these and other observations,[3] a close study of the process of natural purification of flowing sewage was made, and the main results are given here. The physical features of the sewage channels at Bangalore, the zones in the channels broadly divisible in accordance with the stages of purification, the fauna and flora in them and the average results of analysis (obtained over a period of about ten years) of the sewages at different points in the channels are given in Tables I to IV. Photographs showing the condi-

Table I

The physical features of the sewage channels up to the regions in which the sewages are purified

	Channel having the gradient		
	1-in-50	1-in-100	1-in-800
Volume of sewage* (million gallons daily)	4	6	6
Width of the channel (feet)	4 to 12	8 to 20	4 to 10
Depth of the channel (feet)	0·3 to 1·5	0·3 to 2	0·5 to 4
Nature or type of bed ..	More rugged and stony at several points	Not so rugged and stony as in 1-in-50 gradient channel	Least rugged and stony
Depressions permitting sedimentation	At 0·67 mile from the outfall a considerable area of depression at certain points 1½ feet deep	Sewage stagnates at a few points	At 2·17 miles from the outfall there is a natural settling tank about ½ mile long, ¼ mile wide and 3 to 4 feet deep
Dams ..	No dams	One dam 100 feet wide at 3·5 miles from the outfall. Three other similar dams after 6 miles from the outfall	No dams
Distance from the outfall at which sewage is completely purified (in miles)	1·29	4·75	4·46
Time taken by sewage to reach the point of complete purification (hours)	0·7 to 1	2·75 to 3·25	4 to 5
Destination of the channel ..	Joins 1-in-100 channel at the point 3·25 miles from the latter's origin	Joins a river about 20 miles away from the outfall	Joins a rain-fed tank 4·46 miles away from the outfall

* The sewage is mostly domestic in character and composition. About 5,000 gallons of waste water from a small tannery is introduced into the channel 1-in-50 after 0·92 mile from the outfall. About 0·3 million gallons of waste water from 3 small-sized textile mills is introduced into the channel 1-in-100 between 1·25 and 3·25 miles from the outfall. These quantities of industrial wastes did not indicate any effect on the purification of sewage.

Table II

The zones in the sewage channels broadly divisible in accordance with the stages of purification

Zone and stage of purification	Channel having the gradient		
	1-in-50	1-in-100	1-in-800
	Distance in miles from the outfall		
The first zone (preliminary changes leading to clarification and oxygenation)	0 to 0·67	0 to 3·50	0 to 2·71
The second zone (clarification and oxygenation)	0·67 to 0·92	3·50 to 4·00	2·71 to 3·50
The third zone (nitrification) ..	0·92 to 1·29	4·00 to 4·75	3·50 to 4·46
The point at which the purified effluent is used for washing purposes*	1·29	4·75 and beyond	4·46

* Pathogenic organisms have not been found at the point where the liquid is used for washing purposes. This has been ascertained with the kind assistance of the authorities of the Public Health Institute at Bangalore, to whom the authors' thanks are due.

TABLE III

Fauna and flora in the sewage channels

(The list includes the organisms more frequently seen, and the list is by no means exhaustive)

Organisms	The first zone	The second zone	The third zone
Bacteria ..	Bacterial forms (as generally found in domestic sewage)* Occasionally *Salmonella typhi* and *Vibrio cholerae*	Aerobic forms generally	Aerobic forms generally
Sewage fungus ..	Sphærotilus sp.	Not seen generally	Not seen generally
Algæ ..	Not seen generally	do.	Species of Oscillatoria, Ulothrix, Urospora, Stigeoclonium and Pinnularia‡
Protozoa :			
Rhizopoda ..	Species, *e.g.*, of Amoeba and Arcella	These protozoa decreased	Not seen generally
Mastigophora ..	Species, *e.g.*, of Bicosoeca and Euglena	do.	do.
Ciliophora ..	Species, *e.g.*, of Colpoda, Colpidium, Coleps, Stylonychia, Paramecium Vorticella ; and occasionally species of Opercularia, Epistylis and Carchesium	These protozoa increased. But the species of Carchesium and Epistylis developed in stnkingly large numbers forming masses of growth†	Much less growth of these protozoa
Rotifera ..	Not seen generally	Species of Rotifers	Not seen generally
Worms ..	Aulophorus sp.	Aulophorus sp.	do.
Insect Larvæ ..	Mosquito (Culex sp.); Bloodworm (Chironomus sp.)	Chironomus sp.	Mosquito (Anopheles sp.).
Other forms ..	Not seen generally	Snails; fish (*Gambusia affinis holobrookii*); frogs; water hyacinth	Fish ; frogs ; water hyacinth

* In the first zone the bacteria predominated. † In the second zone, the protozoa, colonial Vorticellids predominated (species of Epistylis and Carchesium attached to the surfaces of stones, leaves, snails, etc.). ‡ In the third zone the algæ predominated.

TABLE IV

Results of analysis of flowing sewage at different points in the channels

(Results of chemical analysis expressed as p.p.m.)

Distance in miles from the outfall	pH value	Turbidity*	3-min. permanganate value	4-hr. permanganate value	Biochemical oxygen demand	Dissolved oxygen	Ammoniacal nitrogen (N)	Albuminoid nitrogen (N)	Nitrite nitrogen (N)	Nitrate nitrogen (N)	Total bacteria (millions per ml.)
Channel having 1-in-50 gradient											
0·0	7·0	185	28·7	64·9	244	0·0†	34·2	14·0	Nil	Nil	34·0
0·17	7·4	122	17·3	36·3	167	2·1	24·9	10·4	Nil	Nil	20·0
0·38	7·5	104	13·2	24·4	128	2·7	22·8	8·5	Nil	Nil	16·0
0·67	7·5	88	9·7	17·9	99	3·6	20·5	7·0	0·02	Nil	10·0
0·92	7·8	40	5·1	11·3	32	6·0	9·7	1·94	0·20	0·37	2·0
1·29	7·8	17	2·8	9·0	15	6·7	6·3	0·56	0·44	0·61	0·003
Channel having 1-in-100 gradient											
0·0	7·3	190	25·1	50·9	219	0·0†	41·3	17·4	Nil	Nil	29·1
1·25	7·5	136	16·0	32·6	147	1·4	33·4	10·4	Nil	Nil	22·3
2·25	7·8	115	14·5	30·8	113	1·8	24·7	7·2	Nil	Nil	13·3
3·00	8·1	102	11·1	24·8	98	2·5	17·3	5·9	Nil	Nil	12·5
3·25	8·0	88	9·8	21·2	86	2·9	15·5	4·2	Trace	Trace	—
3·50	7·9	74	7·3	18·7	74	3·4	14·3	3·2	0·04	0·25	6·5
3·75	7·9	29	4·3	13·7	31	5·5	12·8	1·5	0·10	0·29	—
4·75	8·0	20	2·7	9·9	19	6·5	7·3	0·59	0·32	0·50	0·005
Channel having 1-in-800 gradient											
0·0	7·1	269	36·0	73·9	272	0·0†	54·8	18·0	Nil	Nil	35·3
0·88	7·4	188	25·2	48·9	185	2·0	37·2	10·8	Nil	Nil	27·0
2·17	7·4	106	15·5	35·0	139	2·7	28·9	8·0	Nil	Nil	15·0
2·71	7·6	72	8·9	21·5	99	3·7	18·4	5·4	0·04	Nil	10·0
3·50	7·8	47	5·3	14·3	58	6·8	12·8	0·93	0·50	0·10	0·05
4·46	8·0	23	3·0	11·1	18	6·8	9·1	0·45	0·43	0·57	0·01

* Turbidity : Values obtained by using Klett-Summerson photoelectric colorimeter with 420 filter.

† Dissolved oxygen : Occasionally the sewage samples at the outfalls contained negligible amounts of oxygen.

tions at four points in the channel having 1-in-50 gradient are given in Figs. 1 to 4.

the sewage (at 10–25% level, by volume) and the mixture gently shaken or into which air was

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIGS. 1–4. Fig. 1. One of the sewage outfalls at Bangalore: the sewage flows down in an open channel having 1-in-50 gradient. Fig. 2. At 0·67 mile from the outfall, the sewage gushes down a rugged stony area. Fig. 3. Photo micrograph of *Carchesium* sp. (× about 80) found in fluffy masses down the stony area. Fig. 4. The clear, purified effluent (at 1·29 miles from the outfall) being used by washermen.

In the light of the evidence accumulating at Bangalore the more important factors influencing purification of the flowing sewage include: (1) adequate agitation or turbulence of the sewage and other conditions in the channel, which facilitate the dissolution of oxygen to the extent of about 3·5 p.p.m., and (2) the consequent development in large numbers of ciliate protozoa notably of the species of *Carchesium* and *Epistylis* which are always found in activated sludge.[4] When these protozoan colonies were taken out, washed and introduced into

bubbled for 1½–6 hours (depending on the number of the organisms), it was observed that the sewage was clarified and oxygenated almost to the same extent as under the natural conditions in the channels. The flocculating activity of the protozoa and the clarification of the sewage also seemed to explain the relatively high nitrogen contents of the soils under the flowing sewage in the zone of clarification and to bring about nitrification and other changes, *e.g.*, rapid removal of amino acids[5,6] from the sewage, in the succeeding stages of purificati

the channels. The quality of the final effluents from these channels was similar to that from the activated sludge process.

Observations Made at Other Places in India

The evidence collected on the flowing sewage at the Mysore sewage farm, Shimoga, Bhadravati and Madurai[7] also indicated that the extent of agitation of the sewage during its flow is a basic factor in the process of natural purification as it influences the initial oxygenation of the sewage, development of the protozoa and the consequent changes leading to purification. When, however, sewage flowed down in a more or less contour channel, it was not oxygenated or purified to any appreciable extent even after its flow over a distance of 5 miles.[7]

Significance of the Observations

Natural purification of flowing sewage is thus essentially an aerobic process and, under the most favourable conditions, it would proceed rapidly, as observed in the channel having 1-in-40 gradient, and give results attainable only by the activated sludge process. The above observations are of scientific interest as well as of practical importance as they not only relate to a sanitary principle in Nature and its bearing particularly on the modern methods of sewage disposal but indicate the possibility of increasing the efficiency of the activated sludge process and other methods of aerobic treatment of sewage.

1. Mechi, A., *J. Soc. Arts*, 1860, **8**, 261.
2. Pillai, S. C., Monanrao, G. J., Prabhakara Rao, A. V. S., Natarajan, C. V. and Madappa, I. B., *Indian Med. Gaz.*, 1953, **88**, 507.
3. Pillai, S. C., *Ibid*, 1952, **87**, 411.
4. ———, *Curr. Sci.*, 1941, **10**, 84; 1942, **11**, 437; 1949, **18**, 382.
5. Anandeswara Sastry, C., Subrahmanyam, P. V. R. and Pillai, S. C., *Sewage and Industrial Wastes*, 1958, **30**, 1241.
6. Subrahmanyam, P. V. R., Anandeswara Sastry, C., Prabhakara Rao, A. V. S. and Pillai, S. C., *J. Water Pollution Control Federation*, 1960, **32**, 344.
7. Pillai, S. C., *Investigations on Sewage Farming*, Indian Council of Agricultural Research, 1955.

ON A CLASS OF ASYMMETRICAL FACTORIAL DESIGNS

K. KISHEN

Chief Statistician to Government, U.P., Department of Agriculture, Lucknow

KISHEN AND SRIVASTAVA[1,2] have developed general methods for the construction of symmetrical factorial designs. One of the methods given by them is for the construction of the class of $q \times 2^2$ factorial designs—the treatments being all combinations of the three factors A (0, 1, 2, ..., $q-1$), B (0, 1) and C (0, 1)—in $2b$ blocks of $2q$ plots each by use of the associated BIB design $v = q$, b, k, r, λ. They have illustrated the method by constructing the design 7×2^2 in 14 blocks of 14 plots each by use of the associated BIB design $v = 7$, $b = 7$, $k = 3$, $r = 3$, $\lambda = 1$ and have shown that in this design the loss of information on BC is given by

$$L(BC) = \frac{1}{49} \qquad (1)$$

and that on each of the 6 degrees of freedom of ABC by

$$L(ABC) = \frac{8}{49}, \qquad (2)$$

so that the total loss of information on the partially confounded degrees of freedom for BC and ABC in this design is unity, which is a property of balanced designs. In general, for the $q \times 2^2$ design in $2b$ blocks of $2q$ plots each, constructed from the associated BIB design $v = q$, b, $k = t$, r, λ, it can be shown that

$$L(BC) = \frac{(q-2t)^2}{q^2} \qquad (3)$$

and

$$L(ABC) = \frac{4t(q-t)}{q^2(q-1)}, \qquad (4)$$

the total loss of information being, as before, unity.

It would be seen from (3) that when q is odd, the minimum loss of information on BC would be $1/q^2$ for $t = (q-1)/2$. Also, when q is even, this minimum loss would be 0 for $t = q/2$. These would be called *optimum* designs and can be constructed when the associated BIB designs exist. In the latter case, *i.e.*, when q is even, optimum designs can be constructed with only b blocks of $2q$ plots each, thus reducing the number of blocks otherwise required by half. In this note, only designs for $q \leqslant 19$ have been discussed as optimum or near optimum designs can be constructed only in these

cases owing to the existence of the associated BIB designs with the desired parameters, considering only BIB designs with $r \leqslant 10$.

2. *Designs for q Odd.*—We may first discuss designs for q odd. It is known that for $q = 5$ and 9, BIB designs with $k = 2$ and 4, $b = 10$ and 18 respectively exist. In the case of 5×2^2 and 9×2^2 designs, it is possible to construct optimum balanced designs with only 10 and 18 blocks respectively instead of 20 and 36 blocks respectively required by use of the associated BIB designs. For the case 5×2^2, Shah[3] has constructed such a design. A similar design for 9×2^2 has been constructed by first obtaining the design in 18 replications from the associated BIB design $v = 9$, $b = 18$, $k = 4$, $r = 8$, $\lambda = 3$ by writing down the set "X_0, X_1" in the BIB pattern (where X_0 denotes the combinations 00 and 11, and X_1 the combinations 01 and 10 of factors B and C), filling in the remaining places by the set "X_1, X_0", and then taking from 9 of the resulting replicates only those blocks which have $4\,X_0$'s and $5\,X_1$'s and from the remaining 9 replicates only those blocks which have $5\,X_0$'s and $4\,X_1$'s. In this design

$$L\,(BC) = \frac{1}{81} \tag{5}$$

and

$$L\,(ABC) = \frac{10}{81}, \tag{6}$$

the total loss of information being unity, as required.

For $q = 7$, 11, 15 and 19, BIB designs with $b = 7$, 11, 15 and 19 and $k = 3$, 5, 7, 9 respectively exist. Consequently, for the cases 7×2^2, 11×2^2, 15×2^2 and 19×2^2, optimum designs in 14, 22, 30 and 38 blocks of 14, 22, 30 and 38 plots each respectively have been obtained in which the loss of information on BC is $1/q^2$ and on each of the $q - 1$ degrees of freedom of ABC is $(q + 1)/q^2$, where $q = 7$, 11, 15 and 19 respectively.

3. *Designs for q Even.*—We may now discuss designs when q is even. In this case, as remarked above, balanced designs in b blocks of $2q$ plots each can be readily constructed by use of the associated BIB designs with parameters $v = q$, b, $k = q/2$, r, λ for values of q for which these exist. Here the X_0's alone are written in the BIB pattern instead of the set "X_0, X_1" for q odd, and the remaining $q/2$ places in each of the b blocks are filled in by X_1's. Obviously, in these designs, BC is unconfounded. As BIB designs with the above parameters exist only for $q = 4$, 6, 8 and 10 for even values of $q < 19$ ($r \leqslant 10$), the required type of optimum design exist only in the cases 4×2^2, 6×2^2, 8×2^2 and 10×2^2. In these designs,

$$L\,(BC) = 0 \tag{7}$$

and

$$L\,(ABC) = \frac{1}{q-1} \quad (q = 4, 6, 8, 10) \tag{8}$$

so that the total loss of information is, as before, unity, which is a property of balanced designs.

4. *Near optimum designs.*—For $q = 13$, no BIB design with $k = 6$, exists. No optimum design with $L(BC) = 1/36$ can, therefore, be constructed in the case of the 13×2^2 design. However, a BIB design with $k = 4$, $b = 13$ does exist, which enables the construction of a 13×2^2 design in 26 blocks of 26 plots each in which

$$L\,(BC) = \frac{25}{169} \tag{9}$$

and

$$L\,(ABC) = \frac{12}{169}. \tag{10}$$

This is the most efficient design available in this case.

For $q = 16$, no BIB design with $k = 8$ exists. Consequently, no optimum design of the type discussed in para 3 can be constructed in the case of the 16×2^2 design. However, a BIB design with parameters $v = 16$, $b = 16$, $k = 6$, $r = 6$, $\lambda = 2$ exists, which gives a design in 32 blocks of 32 plots each by the method indicated in para 2 for q odd. In this design,

$$L\,(BC) = \frac{1}{16} \tag{11}$$

and

$$L\,(ABC) = \frac{1}{16}. \tag{12}$$

This is the most efficient design available in this case.

For full details regarding the construction and analysis of the designs discussed in this note, the interested reader is referred to the author's paper on the subject to be published elsewhere.

1. Kishen, K. and Srivastava, J. N., *Curr. Sci.*, 1959, **28**, 98–100.
2. — and —, *J. Ind. Soc. Agric. Stat.*, 1960, **11** (1 & 2). 73–110.
3. Shah, B. V., *Biometrics*, 1960, **16**, 115–18.

LETTERS TO THE EDITOR

ULTRASONIC ABSORPTION MEASUREMENTS IN SOME PURE LIQUIDS

In recent years considerable attention is being given to the study of ultrasonic absorption in liquids because of the anomaly that the observed absorption coefficients are usually greater than the theoretical values. The authors have recently developed a technique for the study of absorption in corrosive liquids by using the diffraction method and the results of absorption measurements carried out for some esters and a corrosive liquid using this technique are presented in this communication.

The ultrasonic absorption is measured by the well-known optical diffraction method.[1-3] In this method a parallel beam of monochromatic radiation of constant intensity is passed through the experimental medium which is itself traversed by plane progressive ultrasonic waves in a direction perpendicular to the direction of light propagation. This results in the diffraction of the emergent light, and a measurement of the diffracted light intensity of the first order which is proportional to the sound intensity, for low values of sound intensity, enables the estimation of the ultrasonic absorption coefficient. In the present investigation a sodium vapour lamp driven by a constant voltage transformer is used as the source. The crystal holder is a pyrex glass sheet with a deep circular depression in the centre, which serves simultaneously as the lid of the ultrasonic cell. The bottom surface of this depression will be in contact with the liquid in the cell. The top surface of the lid is silvered and the piezo crystal rests in the depression with a film of oil to give acoustic contact. An electrode pressing on the top silvered surface of the crystal and another on the silvered surface of the lid will serve as the electrodes for exciting the crystal. The diffracted light intensity of the first order is measured accurately by means of a sensitive Photovolt multiplier photometer. An X-cut quartz crystal driven at one of its odd harmonics by a low power, variable frequency Hartley oscillator generated the ultrasonic waves. The frequency is maintained constant using a heterodyne wavemeter of high accuracy. The specially designed all-glass crystal holder was necessary to isolate the corrosive liquid from the silvered quartz crystal. Measurements were carried out at high frequencies of 25 and 35 Mc./sec. such that progressive waves can be easily set up in a small quantity of liquid in the cell. Temperatures of the liquids are maintained constant to within 0·1° C. The values of α/f^2 thus obtained are presented in Table I.

TABLE I

Liquid	Temp. in °C.	$(\alpha/f^2)\times10^{17}$ in nepers/sec.^{2} cm.$^{-1}$		
		Experimental values		Theoretical values
		25 Mc./sec.	35 Mc./sec.	
Phosphorus oxychloride	31·7	199	212	..
Methyl Benzoate	32·7	62·7	61·3	16
Ethyl Benzoate ..	35·0	68·0	49	21
Benzyl Benzoate	40·5	158	132	45
Benzyl formate ..	32·9	..	53·3	14
Benzyl acetate ..	34·2	..	63	18

It is evident from Table I that the observed ultrasonic absorption is considerably higher than the theoretical value, a common feature which has been reported in many liquids. The apparent discrepancy in the observed values of α/f^2 for the two different frequencies in some of the liquids studied is characteristic of the particular liquids and warrants a detailed study of the absorption variation over a wide range of frequencies.

The authors wish to express their thanks to the Council of Scientific and Industrial Research for the financial aid in connection with this project.

Ultrasonic Labs., H. S. RAMA RAO.
Physics Department, B. RAMACHANDRA RAO.
Andhra University,
Waltair, *November* 3, 1960.

1. Willard, G. W., *J.A.S.A.*, 1947, **12**, 48.
2. Burton, C. J., *Ibid.*, 1948, **20**, 186.
3. Krishna Murty, M., *Proc. Ind. Acad. Sci.*, 1956, **43**, 106.

POTENTIAL CONSTANTS OF CERTAIN PLANAR XY_2Z MOLECULES

Using Wilson's[1] FG matrix method and employing the most general force field, the force constants of CH_2O, CD_2O, CF_2O, CCl_2O, BF_2Cl and BBr_2Cl are evaluated. The usual notation is employed in listing the constants in Table I.

TABLE I

f is given in units of 10^5 *dynes/cm.* $p = 2(f_A - 2f_{AA}) + (f_a + f_{aa})$

Molecule	f_D	f_d	f_{dd}	f_{Dd}	p	$f_a - f_{aa}$	$f_{da} - f'_{da}$	f_τ
CH_2O .. }	12·746	4·373	0·033	0·260	1·189	0·704	0·050	0·996
CD_2O .. }								
CF_2O ..	13·347	4·882	1·934	1·258	3·313	1·029	0·200	0·655
CCl_2O ..	11·836	2·471	1·049	−0·080	1·143	0·204	−0·101	0·117
$B^{11}F_2Cl$ ..	3·375	4·405	1·537	0·803	2·331	1·237	−0·700	0·304
$B^{11}Br_2Cl$ ..	4·801	2·276	0·572	1·291	0·549	0·309	−0·016	0·108

TABLE II

Molecule	Authors	f_d	f_D	f_{Dd}	f
CH_2O ..	Venkateswarlu and Sundaram	4·338	11·420	−0·434	0·901
	Present work	4·373	12·746	0·260	0·996
CF_2O ..	Lovell *et al.*	4·838	14·387	..	0·334
	Venkateswarlu and Sundaram	8·381	12·320	1·380	0·441
	Present work	4·882	13·347	1·258	0·655
CCl_2O ..	Venkateswarlu and Sundaram	2·369	12·860	0·943	0·119
	Present work	2·471	11·836	−0·08	0·117

TABLE III

Molecule	d (Å) (Calculated) (Badger's rule)	d (Å) (Experimental)	D (Å) (Calculated) (Badger's rule)	D (Å) (Experimental)
CH_2O .. }	1·09	1·07	1·21	1·23
CD_2O .. }				
CF_2O ..	1·36	1·32	1·20	1·17
CCl_2O ..	1·79	1·74	1·22	1·18
BF_2Cl ..	1·43	1·29	1·69	1·73
BBr_2Cl ..	1·88	1·87	1·67	1·73

D, d represent the X-Z and X-Y bond distances; A, a the Y-X-Y and Y-X-Z interbond angles and τ the out-of-plane displacement of X-Z bond with respect to the XY_2 plane.

Table II shows a comparison of the force constants with those of earlier workers,[2,3] who used a less general force field.

Interatomic distances are calculated using Badger's empirical rule[4] and the force constants. These are listed in Table III along with the experimental values.

The vibrational frequencies of the molecules recalculated using the above force constants are in good agreement with the observed frequencies.

Details are being published elsewhere.

Dept. of Physics, P. BABU RAO.
S.V. University College, K. SREERAMAMURTY.
Tirupati, *November* 1, 1960.

1. Wilson, E. B. Jr., *J. Chem. Phys.*, 1939, **7**, 1041; 1941, **9**, 76.
2. Lovell, R. J., Stephenson, C. V. and Jones, E. A., *Ibid.*, 1954, **22**, 1953.
3. Venkateswarlu, K. and Sundaram, S., *Ibid.*, 1957, 202.
4. Badger, R. M., *Ibid.*, 1934, **2**, 128; 1935, **3**, 710.

MAGNETISM AND MOLECULAR STRUCTURE: THE ESTIMATE OF METAL-NITROGEN BOND EFFECT IN ZINC CHLORIDE COMPLEXES OF ORGANIC BASES

VARIOUS attempts have been made to correlate the basicity of the donor atom in a complexing molecule with its ability to form a metal complex. Among the various methods which have been employed to get the idea of the metal ligand bond strength, magnetic susceptibility also has been of use. In the present investigation an attempt has been made to estimate the relative strengths of metal-nirogen bond for different addenda in the complexes of zinc with pyridine, quinoline, and aniline and its derivatives by comparing their molar susceptibilities with that of zinc diammine.

The pyridine and quinoline complexes of zinc were prepared by following the methods suggested by Lang[1] and Borsbach[2] respectively. Complexes of aniline and its derivatives were prepared by the methods suggested by Lachowicz and Bandrowski[3] and Tombeck.[4] The purity of these complexes was ascertained by estimating the halogen contents in them.

Magnetic susceptibilities of the complexes and their components were measured by a modified form of Gouy's balance described by Prasad *et al.*[5] These results are given in Table I A in which χ and χ_m denote respectively the specific and molar susceptibilities expressed in -1×10^{-6} c.g.s. units.

The complexes studied in this investigation are analogous to the diammine of zinc, susceptibility of which has been measured by Khopkar[6] in this laboratory. If it is assumed that ammonia molecule in zinc diammine is substituted by the ligand molecule, the difference in the molar susceptibility of the two complexes should represent the difference in the susceptibility of the ligands, *viz.*, the organic base and as depression due to the bond strength between the metal and nitrogen. The calculated values of $\Delta\chi_m$ and $\Delta\chi_m'$ are given in columns 3 and 6 respectively of Table I B. The differences in $\Delta\chi_m$ and $\Delta\chi_m'$ (denoted as λ) are given in the last column of the same table.

The molar susceptibilities of anhydrous complexes were obtained by subtracting the calculated value of the susceptibility of water mole-

TABLE I A

Name of the complex	χ	χ_m	Name of ligand	χ_m
Dipyridine zinc chloride ..	0·489	143·9	Pyridine	46·92
Diquinoline zinc chloride ..	0·547	215·9	Quinoline	87·52
(i) Dianiline zinc chloride-dihydrate (*ortho*) ..	0·545	(i) 195·5	Aniline	62·55
(ii) Anhydrous ..	..	(ii) 174·56	..	..
Ditoluidine zinc chloride-dihydrate (*ortho*) ..	0·577	(i) 222·8	*o*-Toluidine	74·54
		(ii) 201·86 (anhydrous)	..	..
Ditoluidine zinc chloride (*meta*) ..	0·553	193·9	*m*-Toluidine	74·40
Ditoluidine zinc chloride (*para*) ..	0·554	(i) 213·9	*p*-Toluidine	72·58
		(ii) 192·96 (anhydrous)	..	..
Dixylidine zinc chloride-dihydrate (*meta*) ..	0·560	(i) 232·3	*m*-Xylidine	86·90
		(ii) 211·36 (anhydrous)	..	..
Diammine zinc chloride ..	..	98·77	Ammonia (liquor)	19·00

TABLE I B

Complex	χ_m	$\Delta\chi_m$	Ligand	χ_m'	$\Delta\chi_m'$	$\frac{\Delta\chi_m - \Delta\chi_m'}{2} = \lambda$ per Zn-N bond
$ZnCl_2 \cdot 2C_5H_5N$ ..	143·9	45·13	$2C_5H_5N$	93·84	55·84	− 5·35
$ZnCl_2 \cdot 2NH_3$ ..	98·77		$2NH_3$	38·00		
$ZnCl_2 \cdot 2C_9H_7N$ ..	215·9	117·13	$2C_9H_7N$	175·04	137·04	− 9·95
$ZnCl_2 \cdot 2NH_3$ ..	98·77		$2NH_3$	38·00		
$ZnCl_2 \cdot 2C_6H_5NH_2$ ..	174·56	75·79	$2C_6H_5NH_2$	125·10	87·10	− 5·65
$ZnCl_2 \cdot 2NH_3$ ..	98·77		$2NH_3$	38·00		
$ZnCl_2 \cdot 2C_7H_7NH_2$ (*ortho*)	201·86	103·09	$2C_7H_7NH_2$ (*ortho*)	149·08	111·08	− 3·99
$ZnCl_2 \cdot 2NH_3$ ..	98·77		$2NH_3$	38·00		
$ZnCl_2 \cdot 2C_7H_7NH_2$ (*meta*) ..	193·9	25·13	$2C_7H_7NH_2$ (*meta*)	148·80	110·80	− 7·83
$ZnCl_2 \cdot 2NH_3$ ..	98·77		$2NH_3$	38·00		
$ZnCl_2 \cdot 2C_7H_7NH_2$ (*para*) ..	192·96	94·17	$2C_7H_7NH_2$ (*para*)	145·16	107·16	− 6·48
$ZnCl_2 \cdot 2NH_3$ ..	98·77		$2NH_3$	38·00		
$ZnCl_2 \cdot 2C_8H_9NH_2$ ..	211·36	112·59	$2C_8H_9NH_2$	173·80	135·80	−11·60
$ZnCl_2 \cdot 2NH_3$ ..	98·77		$2NH_3$	38·00		

cule from that of corresponding hydrated compounds assuming the susceptibility of water molecule to be the sum of Pascal's constants for two atoms of hydrogen and one atom of oxygen. The usual practice of using the observed value ($\chi_m = 12{\cdot}96$) for such calculations is avoided as it is believed that the high value of 12·96 as against 10·47 used here is due to hydrogen bonding and therefore not strictly applicable in such calculations.

It is apparent from the results that $\Delta\chi_m$ values are lower in all cases. Assuming that the λ value is a measure of bond depression per metal-nitrogen link arising from a change in the strength of metal-nitrogen bond when nitrogen in ammonia is replaced by nitrogen in the ligand concerned, it is seen that these values become more negative in the order *ortho*-toluidine > pyridine > aniline > *para*-toluidine > *meta*-toluidine > quinoline > *meta*-xylidine.

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Department of Chemistry, Institute of Science, Bombay-1, *August* 22, 1960.

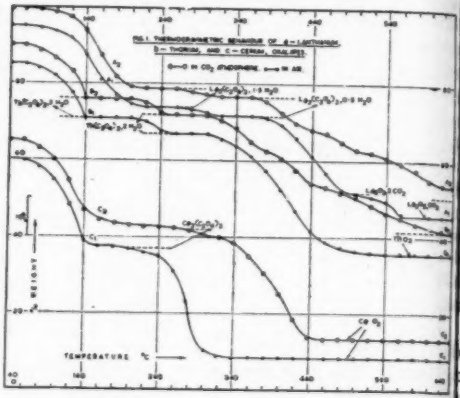
V. G. Sonalkar.
M. G. Datar.

1. Lang, *Ber.*, 1888, **21B**, 157 8.
2. Borsbach, *Ber.*, 1890, **23 B**, 431.
3. Lachowicz and Bandrowski, *Monatsh.*, 1888, **9**, 510.
4. Tombeck, *Comp. rend.*, 1897, **124**, 961; 1897, **124**, 1531.
5. Prasad and co-workers, *Proc. Ind. Acad. Sci.*, 1944, **20 A**, 224.
6. Khopkar, Unpublished work.

THERMOGRAVIMETRIC BEHAVIOUR OF LANTHANUM, THORIUM AND CERIUM OXALATES.IN AN ATMOSPHERE OF CARBON DIOXIDE

While studying the thermogravimetric behaviour of hydrated oxalates of lanthanum, thorium and cerium, it was observed in the present investigation that the temperature of decomposition is raised and the reaction is slow if the oxalate is heated in an atmosphere of carbon dioxide instead of air. The undermentioned hydrated oxalates were prepared by standard methods.[1] Their composition was checked by analysis for the oxalate, metal and water contents.[10]

A quartz fibre-spring thermobalance described earlier[2] was employed to study the thermogravimetric behaviour of these oxalates. A stream of pure and dry carbon dioxide was maintained in the jacket housing the thermobalance so that the sample under investigation had no access to oxygen in the air. The thermograms of the oxalates heated in air and in carbon dioxide atmosphere are presented in Fig. 1 for purposes of comparison.



Thermograms of Lanthanum Oxalate: $La_2(C_2O_4)_3\ 10\ H_2O$

The dehydration of the salt in air commences at 60° (curve A_1) in Fig. 1 and the weight continues to fall till about 200–20° C. and then the weight remains more or less steady till about 400° C. This nearly horizontal portion of the curve may be resolved into two parts one corresponding to the oxalate with 1·5 moles of water associated with it (220–60°) and the other corresponding to a hemi-hydrate. A stage corresponding to the anhydrous oxalate could be reached at about 400° C. beyond which the decomposition of the salt becomes rapid. At about 480° C., the product reaches the composition of basic carbonate $La_2O_3.2\,CO_2$, which loses further a molecule of carbon dioxide beyond 480°. The final product obtained corresponds to the composition $La_2O_3.CO_2$ at 560° which remains unchanged even at 600° C. The residue left behind was greyish-white powder.

In an atmosphere of carbon dioxide the hydrated oxalate of lanthanum shows similar behaviour as was found in air up to 400° C. (curve A_2). Beyond this temperature the decomposition becomes sluggish in the atmosphere of carbon dioxide. The horizontal portion starts at about 600° C. and the composition of the residue as determined by the weight lies in between $La_2O_3.2\,CO_2$ and $La_2O_3.CO_2$. The residue obtained at the end of the experiment was found to be shining black powder containing elemental carbon.

Similar results were obtained in the case of thorium oxalate hepta hydrate $Th(C_2O_4)_2.7H_2O$

and cerous oxalate nona hydrate $Ce_2(C_2O_4)_3 \times H_2O$. Thorium oxalate begins to lose water at 60° in air (curve B_1) and this continues till about 140° C. when a tri-hydrate is obtained. The weight remains constant till 200° C. where there is again a slight loss in weight. In the range 240°–300° the sample was found to correspond to a dihydrate. (The dihydrate could be prepared in a separate experiment by heating the hepta hydrate at 240° C. for 2 hours.) The dihydrate loses water at 300° C. and passes through a mono-hydrate stage at 340° beyond which the decomposition becomes rapid. The weight of the residue becomes constant at 400° C. and remains the same till 640° C. and the composition of the final product corresponds to ThO_2.

In an atmosphere of carbon dioxide the dehydration process of thorium oxalate is similar to that in air (curve B_2) till about 300° C. and further weight loss is very much slowed down. The thoria level is reached only beyond 600° C. The residue was dark in colour containing some elemental carbon along with thoria.

The thermogravimetric behaviour of cerous oxalate is somewhat different from the above two salts. The decomposition of cerous oxalate is very much slowed down in carbon dioxide (curves C_1, C_2). If the oxalate is heated in air all the water is lost at about 220° C. and decomposition is quite rapid at the same time. The curve C_1 is very steep between 240° and 320° C. and becomes horizontal at 320° C. The residue left behind is ceric-oxide (CeO_2). While in carbon dioxide the decomposition becomes rapid only after 320° and the curve reaches horizontal level only beyond 440° and the weight of the sample remains constant till about 540°. The residue left was ceric oxide (CeO_2) and no elemental carbon was found to be present along with it.

The thermogravimetric results in air can be compared with the results of earlier workers.[3–9] The results presented here indicate that anhydrous oxalates are very unstable and it is very difficult to make out the two stages corresponding to complete dehydration and decomposition, when they are heated in air. In an atmosphere of carbon dioxide the decomposition can be delayed even after dehydration stage is reached. The delay in decomposition may perhaps be attributed to the delay in nucleation, dissociation of the carbonate and the oxidation of the oxalate. Further work is in progress to elucidate this phenomenon.

The authors wish to express their grateful thanks to Prof. M. R. A. Rao for his keen interest in the work.

Dept. of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore-12, *October* 12, 1960.

O. K. SRIVASTAVA.
A. R. VASUDEVAMURTHY.

1. Fernelius, W. C., *Inorganic Synthesis*, McGraw-Hill Book Company, Inc., 1946, **2**, 59.
2. Vasudevamurthy, A. R., Bharadwaj, D. K. and Mallaya, R. M., *Chem. and Ind.*, 1956, 300.
3. Backer, H. J. and Klaassens, K. H., *Z. anal. Chem.*, 1930, **81**, 104.
4. d'Eye, R. W. N. and Sellman, P. G., *J. Inorg. Nucl. Chem. G.B.*, 1955, **1**, 143.
5. Takayuki Somuya and Shizo Hirano, *J. Soc. Chem. Ind. Japan*, 1939, **34**, suppl. binding No. 11, 459.
6. Wendlandt, W. W., *Anal. Chem.*, 1958, **30**, 58.
7. Chase, W. S., *J. Am. Chem. Soc.*, 1917, **39**, 576.
8. Caro, P. and Lorriers, J., *J. Rech. C.N.R.S.*, 1957, **39**, 107.
9. Beckett and Winfield, *Austr. J. Sci. Res.*, 1951, **4**, 644.
10. Srivastava, O. K. and Vasudevamurthy, A. R., *J. Sci. Ind. Res.* (India), 1960, **19B**, 364.

A NEW COLORIMETRIC METHOD FOR THE DETERMINATION OF DIAZINON

SEVERAL enzymic,[1–4] bioassay[5] and ultra-violet spectrophotometric methods[6,7] are available for the determination of diazinon. Colorimetrically diazinon is determined either by the method of Suter *et al.*,[8] *via* the methylene-blue reaction ($\lambda_{max.}$ 670 mμ), or by the determination of total phosphorus by the method of Holman[9] *via* the molybdenum-blue reaction ($\lambda_{max.}$ 650 mμ). These authors[8] have also used turbidimetric tests with heteropoly acids and infra-red spectroscopy for the detection of small amounts of diazinon. The present note reports a new colorimetric method for the determination of diazinon in biological materials, in residue analysis, etc., by the application of the well-known Janovsky reaction.

An aliquot extract of the sample to be analysed containing about 5–50 μg. of the insecticide is cleaned up by chromatographic, partition separation or other suitable method. The insecticide is then nitrated and the resulting nitro-compound, after extraction, is reacted with methyl ethyl ketone in presence of strong alkali and the transmittancy of the red colour formed is measured at 502 mμ. The minimum detection level is 5 μg. of diazinon.

Sulphur and fungicides of the thiocarbamate type which interfere in the method of Suter *et al.*,[8] and arsenic, silica and other phosphates, which interfere in the Holman method,[9] do not interfere in the new colorimetric method. Interference is caused by compounds which readily get nitrated and especially when the product is a di- or polynitro derivative with two

nitro groups formed in the metaposition to each other. But this interference can be eliminated by suitable separation techniques prior to the nitration step.

The detailed paper will appear elsewhere.

State Forensic Sciences Lab., Madras-3, A. IRUDAYASAMY. A. R. NATARAJAN.
September 21, 1960.

1. Giang, P. A. and Hall, S. A., *Anal. Chem.*, 1951, **23**, 1830.
2. Frawley, J. P., Laug, E. P. and Fitzhugh, O. G., *J. Assoc. Offic. Agr. Chemists*, 1952, **35**, 745.
3. Cook, J. W., *Ibid.*, 1954, **37**, 561.
4. Fallscheer, H. O. and Cook, J. W., *Ibid.*, 1956, **39**, 691.
5. Terriere, L. C. and Kiigemagi, U., *Simplified Bioassay for Insecticide Residues*. Presented at the 129th National Am. Chem. Soc. Meeting, April 1956.
6. Harris, H. J., Geigy Co., *A Tentative Ultraviolet Method for Analysis of Diazinon in Spray Residues*, September 1953.
7. Blinn, R. C. and Gunther, F. A., *J. Agr. Food Chem.*, 1955, **3**, 1013.
8. Suter, R., Delly, R. and Meyer, R., *Z. anal. Chem.*, 1955, **147**, 173.
9. Holman, W. I. M., *Biochem. J.*, 1943, **87**, 256.

RESPROPIOPHENONE OXIME AS A REAGENT FOR THE DETERMINATION OF COPPER

RESACETOPHENONE oxime has been used for the estimation of copper.[1,2] In this note the use of respropiophenone oxime as a reagent for the estimation of copper is described.

Respropriophenone[3] was converted into its oxime by treatment with hydroxylamine hydrochloride. The oxime was recrystallised from ethyl alcohol, m.p. 189° C. (Lit. 186-87° C.).

10·0 ml. of the copper chloride solution was neutralised with 2 N sodium hydroxide solution and then acidified with 2 N acetic acid solution. The solution was diluted to about 200 ml. and heated to boiling. An excess of 1% solution of the reagent was then added dropwise with constant stirring and the solution along with the precipitate was heated to boiling. The brown precipitates obtained were filtered through sintered glass crucible and washed with hot water containing acetic acid till the filtrate gave no colour with ferric chloride solution. The precipitates were dried at 110°–120° C. The copper content of the complex was determined by the decomposition method on the basis of the formula Cu $(C_9H_{10}O_3N)_2$ (Cu Found: 14·97, 14·98, 15·08; Calc. 15·00 m.p. 284° C.). Further work is in progress.

The authors are thankful to Professor S. M Sethna for his interest in the work and Dr. A. M. Talati for useful discussion.

Chemistry Department, Faculty of Science, M.S. University of Baroda, Baroda, *September* 2, 1960. J. S. DAVE. A. R. PATEL.

1. Raju and Neelakantam, K., *Curr. Sci.* (India 1950, **19**, 383.
2. Bhatki, K. S. and Kabadi, M. B., *J. Univ. Bo* 1955, **24** (3), 51.
3. Brewster, C. M. and Harris, J. C., *J. Am. Ch Soc.*, 1930, **52**, 4869.

"VIBRATED" DROPPING MERCURY ELECTRODE

THE behaviour of dropping mercury electro (DME) in an external alternating field has be recently studied by Hideo Imai *et al.*[1] Th found that the polarographic limiting curre in the presence of the alternating field increased beyond the diffusion controlled v At lower values of the alternating field, t limiting current coincides with the diffusi current at the potential of the electro-capilla maximum (ECM). However, at sufficient high values of the field, the limiting curre does not coincide with the diffusion current ev at the potential of ECM. This technique, whi they have called 'vibrated' dropping mercu electrode (VDME), has been used to determi the potential of the ECM. The above worke have ascribed the increased limiting current the streaming of solution on and near the DM caused by the vibration of the DME in alterna ing field (*i.e.*, 0·55 V/cm.). They have stat that at the potential of ECM, the vibration the DME ceases entirely.

Considering the relatively low intensity of t field in the above study, it appeared to us th the vibration of the mercury drop as a wh may not disturb appreciably the diffusion lay On the other hand, it was felt that the strea ing of the solution by electro-capillaryphores may be the cause of the phenomenon. Accor ingly, the system was observed through a trav ling microscope while illuminating the mercu drop and the solution adjacent to it with

aid of a narrow beam of light from an arc-lamp, condensed with a lens. Some talc powder was added to make any liquid movements present visible.

The system used was the same as investigated by Imai *et al.*

Solution : 0·001 M Hg^{2+} in 0·1 M KCl.
Drop time : 9·0 Sec. in 0·1 M KCl, open circuit.
Alternating field : 0·55 volt $cm.^{-1}$ rms. ; 50 cycles.

When the alternating field was put on, a well-defined streaming of the liquid took place around the mercury drop. The direction of streaming of solution was found to be the same at all potentials on either side of the ECM. The streaming was from the apex of the drop towards the neck. At the ECM there was no streaming.

We also observed that when a small amount of a surface-active substance like mannoxol OT is added, the streaming of the solution stops altogether at all potentials up to the desorption potential of the surfactant (— 1·32 V for mannoxol OT) beyond which the streaming starts again.

In all the above experiments, whenever there was no streaming, normal diffusion currents were obtained. Under similar experimental conditions electro-capillaryphoretic movements were also observed in the case of the hanging mercury drop (the drop adhering to a gold-plated platinum electrode). These movements, however, are not reproducible as the surface appeared to be easily contaminated by surface active impurities.

Differences in interfacial tension appear to be the cause of the well-defined streaming of the solution. The direction of streaming indicates a higher interfacial tension at the neck than at other regions.

It appears to us that the effect of the applied alternating voltage is heterogeneous over the surface of the drop. One of the causes might be that the field would be relatively small at the neck of the drop due to the shielding effect of the capillary and large at the portions which are nearer to the electrodes. As a consequence, different regions are polarised to different degrees. Hence due to electro-capillary effect, the different regions of the mercury drop acquire different interfacial tensions, the neck having a higher interfacial tension than the other regions. Consequently, mercury at the interface flows from the region of low interfacial tension to that of high interfacial tension, *i.e.*, from apex to the neck ; the solution adjacent to the mercury surface flowing along with it thus causing a streaming of the solution.

Thus it appears electro-capillaryphoresis is responsible for the increased limiting current.

In view of the above findings, it is suggested that any mechanical vibratory movement of the drop that may exist may be mainly caused as a result of changes in interfacial tension and may have a subsidiary importance as far as polarographic behaviour is concerned.

Some other related aspects of the phenomenon will be dealt with in a later communication.

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Central Electrochemical Research Institute, Karaikudi (India),
R. NARAYAN.
V. K. VENKATESAN.
K. S. G. DOSS.
September 7, 1960.

1. Imai, H., Inouye, S. and Chaki, S., *Bull. Chem. Soc.*, Japan, 1958, **31**, 767 ; 1959, **32**, 994.
2. Doss, K. S. G., *J. Sci. and Ind. Res.*, 1946, **5 B**, 58.
3. Frumkin, A. N., *J. Electrochem. Soc.*, 1960, **107**, 463.

A HEAT-RESISTANT AND ACID-TOLERANT YEAST FROM *PASSIFLORA EDULIS* SIMS.

IN thermal processing or spin-pasteurization of canned fruit products,[1] it is customary to isolate the most heat-resistant organism from the product under test and determine its thermal characteristics with special reference to its thermal-death-time data. During our studies on the isolation of spoilage organisms in passion fruit juice (*Passiflora edulis* Sims.),[2,3] a survey of literature revealed little published information on the subject. The present report briefly covers this aspect.

Fresh passion fruit juice has, on an average,[4] 17·3°Brix, 3·4% acidity (as anhydrous citric acid), 2·83 pH, 3·2% reducing sugars, 4·6% non-reducing sugar (sucrose), 10·0% total sugars, 2·4% starch, 0·8% protein, 0·46% mineral matter and 34·6 mg./100 g. of ascorbic acid. Despite its low pH, the fresh juice, when exposed to atmosphere at room temperature, usually got spoiled within 48-72 hours. A microscopic examination of the spoiled juice showed the presence of only yeast cells. The causal organisms were isolated by the

plating out technique,[5] using P.D.A. Two strains of yeast were isolated and designated as P_1 and P_2. Well-developed colonies were transferred to slants of the same medium. The morphological and physiological characteristics[6] of P_1 and P_2 organisms revealed that P_1 was *Candida krusei*, while P_2 was found to be a non-sporulating strain of *Sacch. delphensis*.[7]

The comparative heat-resistance of the two isolates (P_1 and P_2) were then studied as follows :—

Two lots of passion fruit juice filled in sterilised cans (301 × 309) were inoculated with the two isolates (P_1 and P_2) separately, the load in each case being 10^6/ml. The cans were then sealed and spin-heated under atmospheric steam while the cans were spun axially at 150 r.p.m. for 0, 1, 1¼, 1½ and 2 minutes separately. Duplicate cans were used for each run. Each can was then spin-cooled to room temperature under sprays of cold water, wiped dry, opened aseptically and the material was plated out on P.D.A. as usual. The typical results of a run (Table I) clearly show the comparatively much higher thermal resistance of the strain P_1 which, under the above conditions, could survive a temperature of 74° C., in a medium at pH 3·4.

TABLE I

Comparative heat-resistance of the spoilage organisms in passion fruit juice (P. edulis *Sims.*)

Expt. No.	Spin-heating time (min.)	Can centre temp. (°C.)	Spoilage organisms	
			P_1 *C. krusei*	P_2 *S. delphensis*
1	0	29·0	+	+
2	1	61·0	+	+
3	1¼	72·0	+	−
4	1½	74·0	+	−
5	2	82·0	−	−

+ = Growth ; − = No growth.

Systematic studies were then undertaken to determine precisely the thermal-death-time for this more heat-resistant and acid-tolerant yeast (*C. krusei*), by using the thermal-death-time glass tubes (Pyrex ⅜″ × 3½″). The 'z' value or the logarithmic scale of thermal destruction for this organism was found to be 9° C.

With a view to find out the pH limits of growth[8] and the activity of these two strains of yeast in comparison to the known strains of yeast normally used for alcoholic fermentation tests for their acid tolerance were, therefore, carried out using the artificial medium yeast extract-peptone-dextrose broth (in Durham tubes). The results are shown in Table II.

TABLE II

Comparative acid-tolerance of yeasts

	Organisms	Acids used (pH 2·8)					Natural juice (pH 2·8)
		H_2SO_4	HCl	Citric acid	Malic acid	Mixture of citric and malic acid (95 : 5)*	
1	*Sacch. cerevisiæ*	+	÷	−	+	+	+
2	*Sacch. ellipsoideus*	+	+	+	+	+	+
3	*Candida krusei*	+	+	+	+	+	+
4	*Sacch. delphensis*	+	+	+	+	+	+

* As normally found in passion fruit juice.[9]
+ = Positive fermentation ; − = No fermentation.

The concentration of citric acid or the lowest pH, the isolated strains could tolerate, was determined by using different concentrations of citric acid in yeast extract-peptone-dextrose broth (in Durham tubes). The results are given in Table III.

TABLE III

Comparative pH tolerance limits of the two passiflora strains

Per cent. citric acid	pH	Passiflora strains	
		Candida krusei	*Sacch. delphensis*
0*	5·3	++	++
1	3·0	++	++
2	2·6	++	++
3	2·5	++	−
4	2·4	++	−
6	2·2	+	−
8	2·1	+	−
10	2·0	+	−
12	2·0	−	−
14	1·95	−	−

* Control medium, without any added citric acid.
++ = Vigorous fermentation ; − = No fermentation ; + = Slow fermentation.

The results (Table III) indicate that *Candida krusei* was more acid-resistant and more heat-resistant (Table I) than *Sacch. delphensis*.

The authors thank Dr. V. Subrahmanyan, Director, and Dr. A. Sreenivasan, Deputy Director, for their keen interest in the investigation.

Division of Fruit Technology, Central Food Tech. Research Institute, Mysore-2, *August* 31, 1960.

J. S. PRUTHI.
B. A. S. RAO
S. A. JALEEL.
GIRDHARI LAL.

1. Pruthi, J. S., *Food Sci.*, 1957, **6** (6), 139 ; **6** (8), 179 ; 1959, **8** (11), 396 ; *Austr. Food Manuf.*, 1957, **26** (6), 12.

2. Pruthi, J. S., *Ph.D. Thesis*, The Panjab University, Solan, India.
3. — *et al.*, *J. Sci. Industr. Res.*, 1958, **17 C** (8), 129.
4. — and Lal, G., *J. Sci. Food and Agri.* (U.K.), 1959, **10** (3), 188.
5. Lodder, J., *The Yeasts—A Taxonomic Study*, Interscience Publishers, New York, 1952.
6. Wickerham, L. J., "Taxonomy of yeasts," *Tech. Bull. No.* 1029, U.S. Dept. Agri., Washington, D.C.
7. Rao, B. A. S. and Pruthi, J. S., *Nature*, 1960, **187** (4734), 342.
8. Lewis, Y. S., *et al.*, *Sci. and Cult.*, 1955, **21**, 220.
9. Pruthi, J. S., *J. Sci. Industr. Res.*, 1958, **17 B** (6), 238.

STUDIES ON BOMBAY RATS: A Note on the Probable Resistance of *B. bengalensis* to Plague

THE following kinds of rats have been collected from the town of Bombay by different workers.[1,2]

Rattus rattus, Rattus norvegicus, Bandicota bengalensis, Bandicota indica and *Mus musculus*. On an average 809,744 rats per annum have been brought to this Institute for the last 22 years. In these collections *Rattus rattus* and *Bandicota bengalensis* are the predominating rats. Figure 1 gives the percentage of these two rats in the collections during 1938 to 1960 (June).

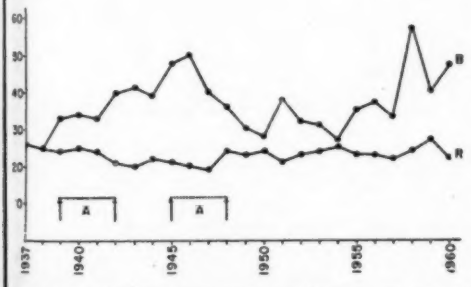


FIG. 1. Showing the percentage of the two rats brought to Haffkine Institute from 1937 to July 1960.
R—Rattus rattus; *B—Bandicota bengalensis*; *A*—Human and rat plague cases observed.

From Fig. 1 it will be noticed that the percentage of *B. bangalensis* shows a distinct increase over *R. rattus* and that there is a periodicity noticed in the peak periods. It is interesting to note that whenever the field rats start increasing, the numbers of house rats are seen going down. This phenomenon may be attributable to the ferocity and size of the field rat, the urbanisation of the town of Bombay and lastly the resistance of *Rattus rattus* and the susceptibility of *B. bengalensis* to plague.[3] There are two known periods marked in Fig. 1 when human and rat plague was in vogue in Bombay. These periods being from 1939 to 1942 and from 1945 to 1951.

TABLE I

Showing the percentage mortality and the average day of death in B. bengalensis *when submitted to a challenge dose of* 195/P.S. P. pestis *at* 5,000 *organisms in the laboratory*

Species treated	Kamatipura		Mahim	
	% Mortality	Average day of death	% Mortality	Average day of death
R. rattus ..	17	12·2	27	5·2
Bandicota bengalensis	80	10·1	92	7·1
Controls (Mouse)	100	5·6	100	5·4

Recently *B. bengalensis* were collected in Bombay from the most crowded ward, *i.e.*, Kamatipura and also from an erstwhile suburb of Bombay, *i.e.*, Mahim. Table I gives the percentage mortality and the average day of death as evinced by this rat from the two wards to a standard challenge dose of *P. pestis*. The results indicate the difference in the percentage mortality, confirming the views expressed[1] earlier about the geographical distribution.

The *B. bengalensis* from Kamatipura were later submitted to a standard challenge dose of 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6} dilution of *P. pestis* (195 P-S/in 0·2 ml.). These results indicate that as compared to laboratory mice *B. bengalensis* is 45% and *R. rattus* 96% resistant to plague.

Sera collected aseptically prior to infection from these rats were tested for anti-body to *P. pestis* and *P. pseudotuberculosis* antigens by the agar-gel double diffusion Oudin reaction.[4,5] It was noticed that the sera from the more resistant rats in Kamatipura displayed anti-body to *P. pestis* and *P. pseudotuberculosis* somatic antigens which are common to both species but not to the specific capsular antigen of *P. pestis*. These observations confirm the experiments of Lawton.[6,7]

The resistance of *Rattus rattus* and the susceptibility of *B. bengalensis* in Bombay and a number of towns in India to *P. pestis* infection is well known. It is of interest to see that while *B. bengalensis* is replacing *R. rattus* in Bombay it is also in the process of acquiring resistance. Details of these results and serological studies are being published elsewhere.

The significance of these studies are attenuated by the recent positive plague rat fall in Birbhum[8] district in Bengal where the rat was *B. bengalensis* and the reports of human plague[9] in the Hosur area of Madras State.

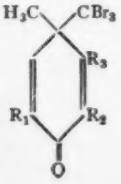
The author is extremely obliged to the Director, Haffkine Institute, for the facilities and to Miss K. K. Patel, Messrs. A. K. Joshi, N. E. Vad, G. C. Chaturvedi and M. K. Habbu for the valuable assistance.

Haffkine Institute, Bombay-12, *August* 31, 1960. P. J. DEORAS.

1. Plague Research Commission, *J. Hyg. Camb.*, **12**, *Plague Suppl.*, 1912, **1**, 229.
2. Deoras, P. J. and Gokhale, M. S., *J. Bom. Nat. Hist. Soc.*, 1958, **55**, 1.
3. *Annual Reports of the Haffkine Institute*, Bombay, 1954, 14; 1955, 16; 1956, 15, 1957, 11.
4. Oudin, J., *Methods in Medical Research*, 1952, **5**, 335.
5. Bhagwan, N. V., Chen, T. H. and Meyer, K. F., *Proc. Soc. Expt. Biol. and Med.*, 1956, **91**, 355.
6. Lawton, W. D., *et al.*, *J. Immunology*, 1960, **84**, 475.
7. Boye, *Bull. Off. inst. Hyg. publ.*, 1932, **24**, 1610.
8. Personal Communication, 1960, Directorate of Health, West Bengal.
9. *Ibid.*, Madras.

SOME REACTIONS OF PHENOLS

p-CRESOL derivatives are known to undergo the Zincke and Suhl reaction with carbon tetrachloride giving cyclohexadienone derivatives.[1,2] In the present investigation *p*-cresol has been reacted with carbon tetrabromide in the presence of anhydrous aluminium bromide to yield 4-methyl-4-tribromomethyl-2, 5-cyclohexadienone (I) of m.p. 146°-47° C. (Calc. for $C_8H_7Br_3O$: Br, 66·8; Found: 66·7). The 2, 4-dinitrophenyl hydrazone of (I) gave m.p. 167° C. (Calc. for $C_{14}H_{11}Br_3N_4O_4$: N, 10·4; Found: 10·7). In a similar manner 2, 6-dibromo-*p*-cresol and 3, 4-xylenol yielded with carbon tetrabromide the corresponding cyclohexadienone derivatives (II) and (III) having m.p. 99°-100° C. (Calc. for $C_8H_5Br_5O$: Br, 77·4; Found: 77·0) and 124°-25° C. (Calc. for $C_9H_9Br_3O$: Br, 64·3; Found: 64·7) respectively. They were characterised by the preparation of crystalline derivatives with 2, 4-dinitrophenylhydrazine.



I: $R_1=R_2=R_3=H$
II: $R_1=R_2=Br$; $R_3=H$
III: $R_1=R_2=H$; $R_3=Me$

(IV)

The compound (I) on a Grignard reaction gave an alcohol (IV), m.p. 177°-78° C. (Calc. for $C_{14}H_{13}Br_3O$: Br, 54·9; Found: 54·6). The latter on treatment with formic acid gave two compounds identified as 4-methyldiphenyl, m.p. 45°-46° C. and 2-methyl-4-phenyl-benzoic acid, m.p. 169°-70° C. Further reactions of the above compounds are being investigated.

p-Ethylphenol and 2, 4-xylenol were found to react similarly with carbon tetrachloride giving oils from which the 2, 4-dinitrohydrazones prepared had m.p. 169°-70° C. (Calc. for $C_{15}H_{13}N_4O_4Cl_3$: N, 13·3; Found: 13·5) and 166°-67° C. (Calc. for $C_{15}H_{13}N_4O_4Cl_3$: N, 13·3; Found: 13·6) respectively.

A detailed report of the work will be published in due course.

Bombay-1, Institute of Science, *October* 14, 1960. J. R. MERCHANT. V. B. DESAI.

1. Newman, M. S. and Pinkus, A. G., *J. Org. Chem.* 1954, **19**, 978.
2. Newman, M. S., Eberwein John and Wood, L. L. Jr., *J. Am. Chem. Soc.*, 1959, **81**, 6454.

INFLUENCE OF EARTHQUAKE SHOCKS ON THE ASKANIA GRAVIMETER SPRING

THE study of continuous variation in the Gravity value with time has engaged the attention of the authors for a period of over two months (June 28th to September 6th). The Gravimeter is the G_{11} type of the Askania Company and the Gravimeter station is located in the basement of the Geology Department of the Osmania University in Hyderabad (Lat. 17° 26′ and Long. 78° 27′). Care has been taken to see that no disturbance is created within the vicinity of the Gravimeter station. During the month of August, disturbances in the general run of the variation curve have been noticed. On the 4th of August at about 1 P.M. a marked drift occurred in the variation curve. For a month prior to this, however, the instrument itself did not show any such or similar drift. In order to explain this sudden change in the behaviour, the authors thought it desirable

examine the Seismic records obtained by the Nizamiah Observatory, which is situated about 3 miles West of the Gravimeter station. It was revealed that an Earthquake shock had been recorded at 13 hrs. 17′ 42″ on the 4th of August, both on the North-South and East-West components. These two records (Gravity and Seismic) stand very well correlated as may be seen from Figs. 1 and 2. Exactly at the same time, when the Earthquake shock was recorded by the Seismograph, the Gravity variation curve also showed a marked drift. A detailed examination of the Seismic records showed that the North-South component of the Seismic record showed a more intense disturbance than the East-West component. This shock had a pronounced effect on the Gravimeter spring, which was itself oriented in the North-South direction at the base station, and consequently on the gravity curve. Disturbances, similar to those on the 4th, in the Gravity variation curve and corresponding Seismic records in the North-South component of the Seismogram of the Nizamiah Observatory were noticed on other days of August 1960. The details are given in Table I.

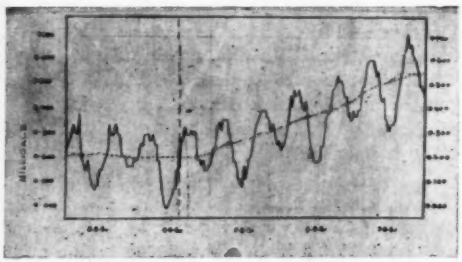


FIG. 1. The dotted line is the Running Mean Line, and vertical line with dashes gives the time of the Earthquake shock.

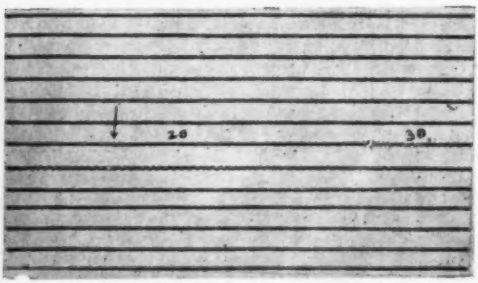


FIG. 2. The North-South component of the Seismic record Arrow indicates the first shock, at 13 h. 17 m. 42 sec.

It is possible to conclude from this data that Earthquake shocks felt within the vicinity of the Gravity station have a considerable effect on the continuous Time-Gravity Variation curve. It suggests that the Gravimeter is acting as an Accelerometer. A closer examination suggests the following points :—

1. The direction of the Earthquake shock, with respect to the orientation of the Gravimeter spring, is a factor of considerable importance.

2. The distance of the epicenter from the Gravimeter base station and also the magnitude of the shock are factors that have a marked effect on the behaviour of the spring and hence on the resulting curve.

The authors desire to express their grateful thanks to Professor Masami Hayakawa for his inspiring guidance and many valuable suggestions throughout this investigation.

Geology Department,
Osmania University,
Hyderabad-7 (India),
November 16, 1960.

S. BALAKRISHNA.
P. V. JOHNSON.

TABLE I

Date	Time	Distance of Epicenter (km.)	Magnitude	Direction from the Gravimeter station	Effect on the spring
4—8—1960	13 hrs. 17′ 42″	9191	Moderate	Southwards	Marked
15—8—1960	20 hrs. 15′ 40″	1765	Slight	N. N-East	do.
23—8—1960	14 hrs. 32′ 47″	2420	do.	Southwards	Slight
27—8—1960	21 hrs. 0′ 31″	~1200	do.	Northwards	Noticeable

ON THE EFFECTS OF DIFFERENT CONCENTRATIONS OF ATMOSPHERIC OXYGEN ON CELL-DIFFERENTIATION IN THE REGENERATE OF THE SNAIL, *HELIX ASPERSA* MULL.

MASS (1939) has shown, that the air-breathing snails, when mechanically stimulated, increase their metabolism considerably and, therefore, an increased need for oxygen can be expected. This fact has been confirmed by him in his experiments with *Helix pomatia*.

The object of this investigation was to find out the effect of different concentration of atmospheric oxygen on cell-differentiation during regeneration. At the normal atmospheric condition, the epithelial cells of the regenerate are columnar and the height is 15·6 μ. It has been also found that the muscles are in the form of fine strands and are randomly arranged. At the same period, the differentiation of the connective tissue is well advanced. The glands of different types have developed in the regenerate. The free blood-cells are found in numbers but it appears to be migrating from the area into the blood spaces.

When different series of animals are treated with 11% O_2, it is found that at a corresponding stage, the epithelial cells are columnar and closely arranged. Their height has significantly increased to 15·12 μ. The developing muscles are not properly orientated. The differentiation of the connective tissue cells is less than the normal regenerate. However, there are masses of blastema and amœbocytes immediately below the epithelium. The hæmocœlic spaces with numerous blood-cells are more than the normal regenerate. The glands have developed and are almost normal.

When animals, after the injury, are kept in 27% O_2, the epithelium is very similar in shape to that of the normal regenerate but the cells are about 13·3 μ in height. A low value of the height of cells, may mean that the epithelium was delayed in the process of growth during that period in high oxygen concentration. The muscle fibres are well developed and have grown below the epithelium have not differentiated so much, as in the normal. The muscle fibres have grown but they are poorly orientated. They are thinner than the normal regenerate.

TABLE I

Cell-differentiation in the regenerate of the snail

	Atmospheric condition	*Epithelium*		Connective tissue	Muscles	Glands		
		Shape	Size in Micron			Mucous	Protein	Calcium
1	Normal ..	Columnar	15·6	Differentiation well advanced	Fine strands randomly arranged	Present	Present	Present
2	With 7% O_2 concentration	Cubical	12·6	Abnormal with oedamatous appearance	Grown poorly orientated	22–50% less in number	Absent	Absent
3	With 11% O_2 concentration	Columnar	15·12	Differentiation less pronounced than normal	Developing muscles poorly orientated	100% normal	100% normal	Absent
4	With 27% O_2 concentration	Columnar	13·3	Well differentiated	Muscles grown almost to the normal	Present as normal	Present as normal	Present as normal

It has been observed, that in concentration of oxygen less than atmospheric, the shape and size of the epithelial cells differ from the normal. At 7% oxygen concentration, the cells are cubical and their height is about 12·6 μ. The difference in the growth processes of the sub-epithelial tissue is quite marked as compared with the animals grown in normal atmospheric conditions. The important point to be made out here, is that the tissue which is unable to differentiate because of low oxygen tension, may be stimulated to do so by increasing the oxygen concentration. The formative cells almost to the base of the epithelium, a condition not usually found in normal regenerate. The number and the size of the hæmocœlic spaces have reduced. Different types of glands have been observed in the repaired region.

Barth (1938) has shown that oxygen can be the determining factor in the rate of regeneration in *Tubularia* stems. Tyler (1933) concluded from his work on sea-urchin embryos that differentiation requires the expenditure of metabolically released energy in addition to that required for maintenance. In the present experiment it was observed that the differentia-

tion of tissue in low oxygen concentration was very little. The retardation in redifferentiation of the formative cells may be due to inadequate availability of energy. Oxygen affects the quality of the regenerate as in insect metamorphosis (Needham, 1942). It therefore affects differentiation as well as proliferation. Therefore, low oxygen tension was found to retard regenerative processes generally.

Goldin (1942) has shown that certain inhibitors produced by the *Tubularia* stem also play a role during regeneration. An increase in the concentration of oxygen will antagonize the inhibitor allowing more tissue to partake in the process of regeneration.

A low value of the height of the epithelial cells, means that regenerate was delayed even during the period in high oxygen tension. Anderson (1956) has shown that the availability of oxygen acts as a limiting factor in the progress of later process in morphogenesis without playing any necessary part in the initiation of regeneration in *Tubifex*. Barth (1944) has concluded from his work on *Tubularia* that the amount of regeneration at low oxygen was almost equal to a delay at high oxygen.

The author is grateful to Professor A. Graham, University of Reading, England, for guidance and encouragement in this work.

Department of Zoology, B. P. Pande.
C.M. College, Bihar University,
Darbhanga, Bihar, *September* 27, 1960.

1. Anderson, J. C., *Biol. Bull.*, 1956, **111**, 179–89.
2. Barth, L. G., *Ibid.*, 1938, **74**, 155–77.
3. —, *Physiol. Zool.*, 1944, **17**, 355.
4. Goldin, A., *Biol. Bull.*, 1942, **82**, 340–46.
5. Maas, J. A., *Zschr. vergl. Physiol.*, 1939, **26**, 605–10.
6. Needham, J., *Biochemistry and Morphogenesis*, Cambridge, 1942.
7. Tyler, A., *Pubbl. Staz. zool. Napali*, 1933, **13**, 155–61.

AMINO-ACID CONSTITUENTS OF ADULTS OF THE CARPET BEETLE, *ANTHRENUS VORAX* WATERHOUSE (DERMESTIDAE : COLEOPTERA)

The free amino-acid constituents of adults of *Anthrenus vorax* Waterhouse, a serious pest of wool, were qualitatively studied by the descending technique of paper partition chromatography of Consden, Gordon and Martin.[1] Adults of *A. vorax* of both the sexes were starved for 24 hours in order to clear the alimentary canal. They were thoroughly rinsed with double distilled (glass) water to remove extraneous material adhering to the body surface of the insect and were ground with anhydrous sodium sulphate and 95% ethanol. The homogenates were centrifuged three times at 3,000 r.p.m., each time for about 10 minutes after which supernatants were reduced to 0·2 ml.

As usual the material and standards were spotted on Whatman filter-paper No. 1 (18·25″ × 22·5″). Different combinations of *n*-butanol, acetic acid and water were tried and the best separation of free amino-acids was secured by using this solvent mixture in the ratio of $4 : 1 : 5^2$ (*v*/*v*/*v*). The chromatograms were run four times and after each run the papers were dried for 6 to 8 hours before running again. After the last run, the chromatograms were allowed to dry overnight and then sprayed with 0·1% ethanolic ninhydrin solution. The chromatograms were dried for an

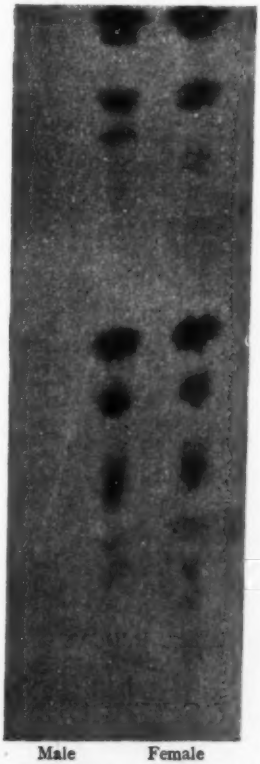


FIG. 1. Chromatogram of *Anthrenus vorax*.

hour and then kept in dark for 24 hours after which they were kept in an electric oven at 85°–90° C. for ten minutes to develop the spots. The spots were identified by comparing their R_f values with the R_f values of the standards

which were run side by side in the same chromatographic chamber. The entire investigation was carried out at a temperature of 27° ± 1° C. except where mentioned otherwise.

At least the following eleven free amino-acids (Fig. 1): lysine, serine, glycine, glutamic acid, alanine, proline, tyrosine, tryptophan, valine, methionine and isoleucine/leucine were detected by the present technique as the body constituents of the adult carpet beetle of both sexes. Qualitatively there did not appear to be any difference in the constituents of amino-acids in male and female adults.

The writer is thankful to Dr. E. S. Narayanan for his keen interest in this work.

Division of Entomology, Indian Agricultural Research Institute, New Delhi-12, *August* 11, 1960.

SNEHAMOY CHATTERJI.
PRAKASH SARUP.

1. Consden, R., Gordon, A. H. and Martin, A. J. P., *Biochem. Jour.*, 1944, **38**, 224.
2. Slotta, K. H. and Primosigh, J., *Nature*, 1951, **168**, 696.

UTILISATION OF THE TECHNIQUE OF VEGETATIVE PROPAGATION IN RICE BREEDING

IT is generally observed that under Cuttack conditions, hybrid seeds of artificial crosses lose their viability much earlier than normal seeds, although stored under similar conditions. In a hybridization programme, involving mass production of crossed seeds, hybridization has to be kept going throughout the whole year. Crossed seeds collected during July-October lose their viability by the end of February.

An obvious method of overcoming this difficulty is to grow the hybrid seeds collected during July-October in the second crop season (January to April). The F_1 plants grown during this season, however, show high seed sterility; but the stubbles from these plants can be carried over and grown in the next *Kharif* season (July to October). The method is also useful in getting enough F_1 seeds for growing large F_2 generation particularly where high sterility occurs.

In research stations, the need is often felt for some F_1 hybrid material either for back crossing to one of the parents, or for verifying some F_2 observations that may have been taken in earlier years. This becomes possible by maintaining F_1's through vegetative propagation from stubbles year after year. Often interspecific crosses in rice are either almost or completely sterile and the only method available to retain the hybrids for any further work is to maintain them by stubble planting. This is being done at the Central Rice Research Institute, Cuttack, and a large number of F_1's of various crosses are being maintained.

STUBBLE PLANTING—AN AID IN THE STUDY OF INHERITANCE OF PHOTOPERIOD SENSITIVITY

In a programme aimed at studying the inheritance of photosensitivity, sensitive varieties are crossed with types, either insensitive or low-sensitive to photoperiod. Since most of the sensitive varieties are short-day plants, F_1 plants are grown in the second crop season (January to April) when the days are longer during the period preceding flowering. If the plants flower during this season, they are taken to be insensitive. To get over the practical difficulty of procuring enough F_2 seeds, the F_1 stubbles are grown in the *Kharif* season (July to October) and the seeds collected from them are grown in the second crop season. The plants selected from the F_2 generation as either insensitive or low-sensitive are stubble-planted in the *Kharif* season and the seeds obtained therefrom are used for growing the F_3 cultures in the second crop season.

UTILISATION OF HYBRID VIGOUR

There is marked vigour observed in F_1's of many crosses in rice in respect of height, number of ear-bearing tillers and yield. One method of taking advantage of the hybrid vigour might be to multiply the F_1 hybrids through stubbles. The best method of propagation is under study and this has been referred to already by the senior author elsewhere.

Central Rice Research Inst., Cuttack-4, *August* 27, 1960.

R. H. RICHHARIA.
B. MISRO.

1. Richharia, R. H., *Rice News Teller*, 1960, **8**(1), 8.
2 —, *Sci. and Cult.*, 1960 (in press).

EFFECT OF CERTAIN ORGANIC INSECTICIDES ON THE YIELD OF CROPS (PART II)

IN an earlier paper[1] the writer has described the effect of the application of some synthetic insecticides on the growth and yield of certain crops. In those trials insecticidal treatment was given at more frequent intervals than usual and in the absence of insect infestations. The emphasis was therefore on the reactions, if any, of the plant-body to the insecticidal treatment and not on the effect of such treatment on insect populations affecting the concerned crops.

TABLE I

Results of phytotoxicity trials (Series II); Frequency: weekly

Trial No.	Crop	Area sq. ft.	Insecticide	Number of treatments	No. of plants	Results: yield per plant
1	Potato ..	27	E, 2 c.c./gal.	9	Tr. 31	2 tubers 27·7 gm.
		C.(30)			C. 28	3·8 ,, 57 ,,
2	do. ..	49	M, 6 ,,	10	Tr. 27	2·4 ,, 69 ,,
		C.(60)			C. 33	2·7 ,, 78 ,,
3	Radish ..	42	F, 3 ,,	5	Tr. 16	3·3 oz. (with leaves) 1·7 oz. (without leaves)
					C. 23	1·85 ,, 0·9 ,,
4	Garden beans	36	F, 3 ,,	10	Tr. } Not recorded	356 beans 1129 gm.
					C. }	332 ,, 1088 ,,
5	Potato ..	36	G, 5 ,,	9	Tr. 38	4·9 tubers 37·3 ,,
					C. 34	2·47 ,, 23·8 ,,
6	Radish ..	15	H, 1 lb./8 gals.	5	Tr. 79	48 gm. (with leaves) 25·3 (without leaves)
			A 10 c.c./gal.		Tr. 64	75·8 ,, 39 ,,
			HC 10 ,,		Tr. 61	73·7 ,, 37·7 ,,
			F 3 ,,		Tr. 46	75 ,, 36 ,,
					C. 65	42·3 ,, 24·6 ,,
7	Tomato ..	50	DDT 1 lb./16 gal.	23	Tr. 35	4·8 fruits 94·9 gm.
					C. 24	0·38 ,, 6·3 ,,
8	Potato ..	39	M, 6 c.c./gal.	6	Tr. 28	1·8 tubers 16·6 ,,
					C. 24	2·6 ,, 18 ,,
9	do. ..	34	*DS 2% ,,	8	Tr. 26	1·9 ,, 27·5 ,,
					C. 14	2 ,, 16·4 ,,

Tr. = Treatment; C. = Control.

* Note: Derris Soap was prepared as follows:

Groundnut oil—98 gm.; Derris eliptica powder—5 gm.; Caustic soda—25 gm. (Dissolved in 100 c.c. water); Resin..... a small lump. The oil was heated on a low flame. The other ingredients were added to the warm oil and thoroughly stirred in.

In the present note results of a further set of trials conducted between November 1958 and September 1959 along the same lines are presented. In this series there were 10 trials relating to nine insecticides, *viz.*, Folidol (F) (3 trials), Ekatox (E) (2 trials), Malathion (M) (2 trials), DDT 50% W.P. (2 trials), Gusathion (G), Mongay oil soap (H), 2% Derris soap* (DS), Aldrin (A) and Heptachlor (HC). The crops dealt with were Potato (5 trials), Radish (2 trials), Garden beans, Tomato and groundnut. The first nine trials were laid out in the laboratory compound in small plots varying in size from 15 to 50 sq. ft. and the last trial (on groundnut) in Ramakrishna Krishi Shala (Anekal Taluk) on duplicated 2-gunta sub-plots. There were check plots of approximately the same size in all cases. The crops were allowed to remain till the end, being harvested at the end or at intervals, as required.

In Tables I and II are given the data relating to these trials:—

In many of these trials spraying with insecticides has affected the yield one way or the other. Where there is an improvement in yield over the control it is obviously due to factors

TABLE II

Results of phytotoxicity trials on groundnut (Trial No. 10)

Crop: Groundnut. *Sub-plot size:* 2 gunats.
Sown: 17—6—1959. *Harvested:* 14—11—1959.
Insecticides:—(*a*) Aldrin .. 10 c.c. per gallon.
(*b*) Heptachlor .. ,,
(*c*) DDT 50% W.P. 1 oz. per gallon.
(*d*) Folidol .. 2 c.c. per gallon.

Each insecticide was applied in two sub-plots as shown in the following sketch:

A	B	C	D	E
Aldrin	Heptachlor	DDT	Folidol	Control
F	G	H	I	J
Control	Folidol	DDT	Heptachlor	Aldrin

Frequency: Fortnightly. *No. of treatments:* 9

Harvest data

Treatment	Average weight of pods harvested (lb.)	Variation from check	By measure (Mysore seers)	Variation from check
Aldrin ..	52	+ 2	31·8	+ 0·3
Heptachlor ..	32½	−17½	20·5	−11
DDT 50% ..	51½	+ 1½	32	+ 0·5
Folidol ..	56½	+ 6½	35½	+ 4
Control ..	50	..	31½	..

other than pest control since no infestation was observed in these trials. Similarly where the yield is less than in the control, treatment should be considered as one of the factors responsible for it. In either case it may be permissible to infer that the concerned insecticides are absorbed by the plant-body and influence the yield.

Ekatox and Malathion (2 trials) both on Potato, have given adverse results. Similarly Heptachlor on groundnut used in combination with 3 other insecticides has not given favourable results. Spraying with the other insecticides has resulted in increased yields. The performance of DDT 50% W.P. on Tomato (Trial No. 7) deserves mention here. The treated sub-plot has given 4·8 fruits weighing 95 gm. per plant, while the control has yielded 0·38 fruit weighing 6·2 gm. per plant. This large increase under insecticidal treatment requires confirmation by further tests. Hongay oil Resin soap and Derris soap which are in a category different from the other organic insecticides have given encouraging results.

Grateful acknowledgements are due to Dr. M. Puttarudriah, Government Entomologist, for encouragement and advice, and to Mr. D. P. Ramanna, Laboratory Assistant, for help in fieldwork.

Division of Entomology, Department of Agriculture, Bangalore, *June* 3, 1960.

D. SESHAGIRI RAO.

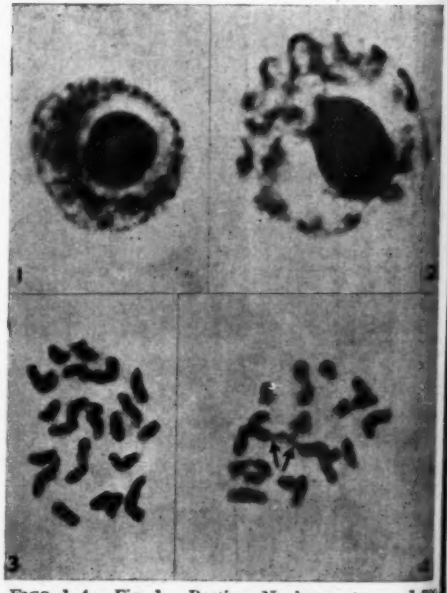
1. Seshagiri Rao, D., *Curr. Sci.*, 1959, **28** (2), 57.

A HAEMATOXYLIN SQUASH METHOD FOR THE ROOT TIPS OF *DOLICHOS LABLAB* LINN.

THE meagre information available on the nuclear cytology of *Dolichos lablab* Linn. is not commensurate with the economic importance of the species.[1–5] The chromosomes are small and the meristematic cells are often refractory to the application of conventional squash methods. This necessitated a search for a simple technique capable of application to such difficult material.

The limitations of aceto-carmine and aceto-orcein techniques are well known.[6,7] Tiwary and Shrivastava[8] devised an aceto-hæmatoxylin method and claimed that it gave pictures superior to those obtained with aceto-carmine. Melander and Wingstrand[9] used Gomori's hæmatoxylin and obtained squashes after treatment with 45% acetic acid. They claimed a high selectivity for the stain and considered it superior to others for difficult material. The limitations of the technique were the variation from material to material of the time of hydrolysis in N HCl at 60° C. prior to staining, the dependence of the affinity of the cytoplasm on the composition of the fixative used and the necessity often of the use of a counterstain for the cytoplasm.

The technique given below stains all cell organelles in differing shades of blue. The root tips of *D. lablab* fixed in acetic alcohol (1 : 3) for 1–24 hr. were either stored in 70% alcohol or used immediately after a thorough wash in distilled water. They were hydrolysed in N HCl at 60° C. for 10–12 min., washed in distilled water, mordanted in 4% ferric ammonium sulphate for 5–10 min., washed in distilled water and stained for 15–20 min. in well ripened hæmatoxylin. They were then washed for 10–15 min. in distilled water and softened with 45% acetic acid at 60° C. To obtain good squashes, the primary roots had to be kept in acetic acid for 8–10 min. while the secondary roots required only 4–5 min. Since acetic acid is the destaining agent, the time of stay in hæmatoxylin had to be adjusted to the time required for softening in acetic acid.



FIGS. 1–4. Fig. 1. Resting Nucleus, × *ca.* 1,700. Fig. 2. Prophase, × *ca.* 2,000. Fig. 3. Polar view of Metaphase, × *ca.* 2,400. Fig. 4. Polar view—Note the pair of satellites, × *ca.* 3,000.

The root tips washed in distilled water were mounted in a drop of 45% acetic acid under a coverslip, squashed and the preparations sealed

with paraffin wax for a general survey. To make them permanent, the paraffin seal was removed and the slide transferred to tertiary butyl alcohol. The separated slide and coverslip were further dehydrated and then mounted in Canada balsam.

Figure 1 shows the resting nucleus with the nucleolus and the early prophase is illustrated in Fig. 2. A polar view of the metaphase plate (Figs. 3 and 4) shows only 22 chromosomes[1,2,5] instead of the 24 reported by some workers.[3,4] Attention is invited to a pair of satellited chromosomes[11] (indicated by arrows in Fig. 4).

The technique gives equally good results in *Phaseolus radiatus*, *Pisum sativum* (Royan, unpublished), *Cicer arietinum*[10] and *Allium cepa* (Subramanyam, S., unpublished).

Cytogenetics Laboratory, K. M. MARIMUTHU.
Dept. of Biochemistry, M. K. SUBRAMANIAM.
Indian Institute of Science,
Bangalore-12, *October* 12, 1960.

1. Karpechenko, *Bull. App. Bot.*, 1924-25, **14**, 143. (Quoted by Ayyangar and Krishnaswamy.)
2. Kawakami, J., *Bot. Mag. Tokyo*, 1930, **44**, 319.
3. Ayyangar, G. N. R. and Krishnaswamy, N., *Curr. Sci.*, 1935, **4**, 739.
4. Rau, N. S., *J. Ind. Bot. Soc.*, 1929, **8**, 201.
5. Roy, P. and Saran, J., *Proc. Ind. Sci. Cong. Abs.*, 1959, **46**, 350.
6. Johansen, D. A., *Plant Microtechnique*, McGraw Hill Book Co., Inc., New York, 1940.
7. Tandler, C. J., *Stain. Tech.*, 1959, **34**, 234.
8. Tiwary, N. K. and Shrivastava, S., *Sci. and Cult.*, 1950, **16**, 163.
9. Melander, Y. and Wingstrand, K. G., *Stain Tech.*, 1953, **28**, 217.
10. Meenakshi, G. and Subramaniam, M. K., *Curr. Sci.*, 1960, **29**, 438.
11. Sen, N. K., and Marimuthu, K. M., *Caryologia*, 1960, **13**, 411.

A CASE OF A SECTORIAL *CHIMERA* IN ONION

At the Vegetable Research Station, Solan, a case of *Chimera* in onion was observed in March, 1960. The seedlings had been transplanted in November–December 1959 for raising a bulb crop. The Development and growth of the crop was normal.

One of these plants showed two, clearly demarcated, longitudinal sectors one green and the other albino as seen in the photograph. The green sector was about two-third of the diameter of leaves and albino about one-third. All the leaves of the plant showed the character clearly. Later in April, as is common in this bulb crop, some of the plants, as also the *Chimera*, sprung up early flowering shoots. The flowering shoot and the unopened umble in the particular plant showed the same demarcated sectors of albino and green.

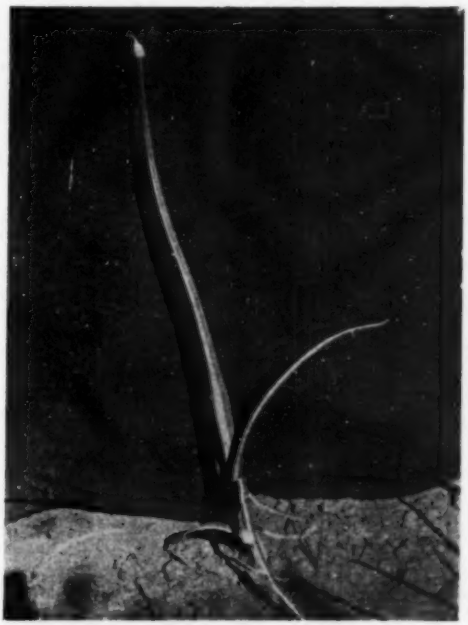


FIG. 1. Taken at the time of springing up of the flowering shoot.

During a severe storm the flowering shoot however broke. The bulb has been carefully stored and will be planted for seed production in the end of the year. The breeding behaviour of the plant will be studied from the seeds and the bulb saved in the second year.

Assistant Vegetable Botanist, S. L. JUNEJA.
Himachal Pradesh, Solan, RAM GOPAL.
July 26, 1960.

A NEW SPECIES OF *CERCOSPORA* ON *LEPTADENIA RETICULATA* WIGHT AND ARN.

Leptadenia reticulata, a common climber, was found to be heavily infested with a species of *Cercospora* in the month of October, 1959, near Udaipur City. Since the fungus has never been reported on this host, a brief description of the causal organism and the symptoms which it causes are given in what follows.

The disease starts with the appearance of olivaceous brown to fuligenous patches on the lower surface of the leaves, presence of which is indicated on the other surface by pale yellow

discolouration in later stages. Large number of such spots of irregular size appear on the leaves which often coalesce and cover the major portion of its surface. Spots also appear on green parts of the stem and branches. In advanced stage of the disease, leaves turn yellow, dry up and ultimately fall off.

Mycelial patches are amphigenous, effuse, irregular, first scattered but later coalesce, olivaceous brown in colour, highly variable in diameter, mostly on green parts of stem and lower surface, rarely on upper surface of the leaves.

Conidiophores fasciculate, arising from submerged synnema, pale olivaceous or olivaceous brown, uniform in colour, somewhat irregular in width, longer ones curved, unseptate to one septate at the base, tip bluntly rounded, spore scars small, measuring 12 to 28·8 $\mu \times 3{\cdot}6$ to 6 μ with an average of 21·6 $\times$ 4·8 μ (Fig. 1 A).

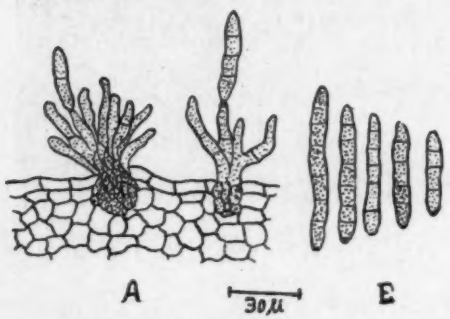


FIG. 1. A—Transverse section of leaf showing conidiophores and conidia. B—Conidia.

Conidia subhyaline to very pale olivaceous, thickwalled, one to more septate, cylindro-obclavate, straight to curved, tip subobtuse to obtuse, fragile, measuring 29 to 126 $\mu \times 3{\cdot}6$ to 5·4 μ with an average of 59 $\times$ 4·4 μ (Fig. 1 B).

On green leaves and stem of *Leptadenia reticulata* Wight and Arn. Leg. R. D. Singh, G. C. Bhatnagar.

Type specimen deposited in the Herbarium of C.M.I., Kew, England, and Herb. Crypt. Ind. Orient, I.A.R.I., New Delhi.

Since no report of any *Cercospora* occurring on *Leptadenia reticulata* Wight and Arn. could be traced out from the available literature, the name *Cercospora leptadeniæ* has been proposed to recognize it as a new species.

Sincere thanks are due to Dr. J. C. F. Hopkins for confirming the identification and to Shri Samarath Raj, Director of Agriculture, Rajasthan, for facilities.

Plant Pathology Section, Department of Agriculture, Rajasthan, Udaipur, *April* 7, 1960.

N. PRASAD.
R. D. SINGH.
G. C. BHATNAGAR.

1. Chupp, C. A., *A Monograph of the Fungus Genus Cercospora*, 1953.

PRELIMINARY STUDIES ON THE EFFECT OF GIBBERELLIC ACID ON GROWTH OF SPINACH (*SPINACIA OLERACEA*)

GIBBERELLIC ACID (GA) is believed to promote the overall expansion and elongation in a wide variety of plant species.[1–3] An attempt was, therefore, made to study the influence of GA on a highly nutritive leaf crop like spinach (*Spinacia oleracea*).

There were six treatments (including control) with three replications of each. Seeds were sown in beds on December 19, and seedlings were thinned to one foot distance (plant to plant and row to row). Seedlings were given three drench sprays of different concentrations of GA (0; 10; 25; 50; 100 and 250 parts per million) at 40, 55 and 70 days after sowing, in randomly selected beds. Control plants were sprayed with distilled water. Height of the main shoot, number of branches and leaves per plant, fresh and dry weight of foliage per plant were recorded 90 days after sowing (Table I).

TABLE I

The effect of different concentrations of GA on the average and ultimate height of plant, number of branches, number of leaves and fresh and dry weight per plant in spinach

GA concentrations in parts per million	Average ultimate height per plant in cm.	Average No. of branches per plant	Average No. of leaves per plant	Average fresh weight per plant in gm.	Average dry weight in gm.
0 (Control)	38·96	3·17	24·66	44·77	12·16
10	90·83	14·66	50·30	378·38	80·16
25	82·83	11·00	42·66	213·06	45·00
50	75·50	11·66	36·33	223·00	50·00
100	70·83	8·43	32·00	101·00	25·76
250	55·20	6·23	28·00	80·00	25·00
C.D. at 5%	13·37	2·47	7·05	19·49	8·36

Table I suggests that different concentrations of GA brought about a marked improvement in the growth of the plants. The maximum average height (90·83 cm.) with 14·66 branches

and material increase in the number of leaves per plant was obtained under 10 p.p.m. (Fig. 1).

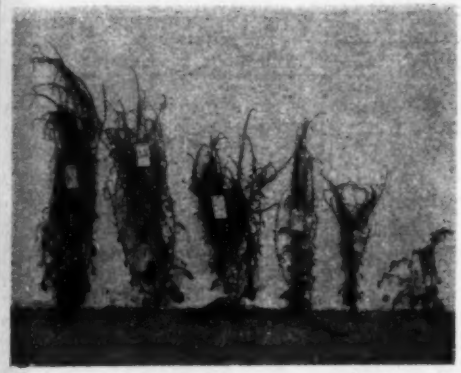


FIG. 1. Influence of different concentrations of GA on the growth of spinach. (*Left to right*) 10 p.p.m., 25 p.p.m., 50 p.p.m., 100 p.p.m., 250 p.p.m. and Control.

Treated plants produced a much higher fresh and dry weight per plant, as compared to untreated ones. Significantly higher fresh and dry weights (378·38 and 80·16 gm. respectively) were also achieved under 10 p.p.m.

It is, thus, obvious that the foliar sprays of the lower concentrations of GA (10 p.p.m.) may be conveniently employed for increased production of spinach.

Govt. Agric. College, Kanpur, *July* 6, 1960.

O. S. JAUHARI.
R. D. SINGH.
V. S. DIKSHIT.

1. Brian, P. W. and Grove, J. F., *Endeavour*, 1957, **16**, 161.
2. Bukovac, M. J. and Wittwer, S. H., *Michigan Agric. expt. Sta. Quart. Bull.*, 1956, **39**, 307.
3. Marth, P. C., Audia W. L. and Mitchell, J. W., *Bot. Gaz.*, 1956, **118**, 106.

THE PRESENCE OF INDOLE-LIKE COMPOUNDS IN PARTHENOCARPIC GUAVA

In a recent communication from this laboratory parthenocarpic development of fruits in guava, *Psidium guajava* L. var. 'Allahabad Round', induced by 'pollen hormone' was reported.[1] It was found that the water extract of pollen grains, when applied to emasculated flowers, was capable of causing parthenocarpic fruits. In order to study the biochemical aspects of the problem, further investigations were made and results are reported here.

Freshly collected pollen grains were extracted, following the method described by Wright,[2] with slight modifications. The pollens were treated for 24 hours with two changes of peroxide-free ethyl ether at 0° C., using 50 ml. of ether per gram of pollen. The ether extract was separated and evaporated to dryness over a water-bath at 60° C. The residue was mixed in lanolin paste and used for treating emasculated flowers. Synthetic auxins were also applied to the flowers in the same manner. The results obtained are summarized in Table I.

The water as well as ether extracts of pollen were found capable of causing parthenocarpic development of the fruits, and of the synthetic auxins tested, NAA, NOA and 2, 4-D were found effective in causing parthenocarpy.

In order to examine the extract for the presence of any indole compound further work was carried out. The flower parts, *viz.*, pollen grains and ovaries at different stages of growth were selected and the ether extracts prepared as stated earlier. The extract was distilled off at 60° C. and the residue digested at 70° C. for five minutes with small quantities of distilled water. The digested material was kept at low temperatures for a day after which the solidified fatty substance containing chlorophyll was filtered off. The filtrate was extracted repeatedly with ether. The ether extracts thus obtained were bulked and treated with one-sixth the volume of 5% sodium bicarbonate solution and the two layers separated with a separating funnel. This process was repeated 5 times. By this process the acidic substances are brought to the bicarbonate fraction, while the non-acidic substances remained in the ether fraction. The bicarbonate fractions were bulked and acidified to pH 3 with 20% tartaric acid and re-extracted three times with equal volume of ether. Then the ether extracts containing acidic fraction were bulked and dehydrated with anhydrous sodium sulphate and concentrated over a water-bath at 60° C. and used for chromatographic differentiation. In the same manner the non-acidic fraction of the extract was concentrated and used for chromatographic differentiation. Both circular and ascending chromatograms were developed with Butanol-ammonia-water (100 : 100 : 8, upper layer) with Whatman No. 1 filter-paper in complete darkness. The indole compounds on the chromatograms were detected by spraying modified Salkowski reagent (10 parts of 5% perchloric acid and 1 part of 0·05 M ferric chloride). Known auxins were used for comparison. Only the acidic fractions were found to contain indole-like compounds and not the

TABLE I

Inducement of parthenocarpy in guava

Treatment	No. of flowers treated	No. of flowers set	Remarks
Water extract of the pollen ..	60	26	The set fruits were parthenocarpic; the unset flowers dropped off in 12 to 15 day.
Ether extract of the pollen ..	120	55	The set fruits were parthenocarpic, but a majority of them dropped off in 20 to 25 days
Naphthalene acetic acid (NAA) 0·5% ..	30	10	The set fruits were parthenocarpic
Naphthoxy acetic acid (NOA) 0·5% ..	30	8	do.
2, 4-Dichlorophenoxy acetic acid (2, 4-D) 0·5%	30	6	do.
3-Indole acetic acid (IAA) 0·5% ..	30	0	There was no set and the flowers dropped off in 12 days
3-Indole butyric acid (IBA) 0·5% ..	30	0	do.
Self-pollinated and bagged ..	60	15	The set fruits were parthenocarpic
Emasculated and bagged ..	60	0	All the flowers dropped off in 12 days

non-acidic fractions, as detected on the chromatograms.

By this method traces of an indole-like compound were detected in the pollens collected immediately after the opening of flowers. In the case of ovaries there was no indication of detectable quantity of the chemical at the time of flower opening, but considerable quantity could be detected in the ovaries collected 5 days after selfing; two fractions of the compound with different *Rf* values were detected on the chromatograms (Fig. 1). But developing young fruits, 20 days after selfing, did not contain any detectable quantity of the indole-like compound. When the flower parts of a seeded variety of guava, *viz.*, 'Red-fleshed' was examined for the purpose, in no case the chemical could be detected on paper chromatograms.

FIG. 1. Chromatographic separation of the ether extracts of guava ovary: G.O.: acidic fraction; N.: non-acidic fraction; K: known compound—IAA; 1 and 2: two fractions of indole-like compound found in the acid fractions of the ether extract.

The indole-like compound present in the pollen grains, and ovaries of 'Allahabad Round' variety of guava gave a pink colour on chromatograms when treated with modified Salkowski reagent, which is the same as that of known IAA. But the *Rf* values of the two unknown fractions were 0·93 and 0·64 as against 0·57 for IAA. It is probable that the fractions are closely related in their molecular structure to IAA. But IAA when applied to the flowers was found ineffective in causing parthenocarpic development of the fruits whereas NAA, NOA and 2, 4-D were fairly effective in this respect (Table I). The colour and the *Rf* values of the latter chemicals on chromatograms were, however, different from those of the unknown fractions as seen in the present studies. The exact identity of these compounds and their relationship to parthenocarpic development of guava remains to be investigated.

Dept. of Agriculture, Annamalai University, Annamalainagar, *September* 5, 1960.

G. RANGASWAMI.
T. T. KALIAPERUMAL.

1. Balasubramanian, V. R. and Rangaswami, G., *Curr. Sci.*, 1959, **28**, 413.
2. Wright, S. T. C., *J. Hort. Sci.*, 1956, **31**, 196.

FACTORS FOR TILLERING IN *SORGHUM* SPP. (*S. SUBGLABRESCENS*)

AMONG the millets in *S. subglabrescens* (Vellai Cholam) and certain other species of *Sorghum* tillering is conspicuously absent. However, the solitary earheads borne on the single stalks are large and heavy compared to earheads of the other millets that tiller well. Single-stalked condition in grain sorghum differs from that in wild sorghum. In the latter the absence of tillering is due to absence of buds at the ground-level, whilst in the former the buds are present and could be activated.[1] The basal shoots that develop from the buds at the ground-level as distinct from the main stem and other secondary shoots are termed the tillers.[2] The factors responsible for suppressing the development of the basal buds were revealed during studies connected with improvement of straw quality of Vellai Cholam through hybridization.

The midrib of sorghum is an index of the straw quality. Dull midrib indicates juicy straw and a white one pithy straw and white behaves as a simple dominant over the dull type.[3] Two non-tillering Cholam strains Co. 18 and K 2 were crossed to transfer the juicy stalk of the former to the latter. The cross was effected in summer season 1956 and F 1 and F 2 studied in subsequent years. The F 1 was single-stalked. There was segregation in the F 2 and the tillered plants were carefully levered out and washed in running water to confirm this habit. The postings for tillered and non-tillered plants together with their statistical significance are presented in Table I.

TABLE I

Counts for	Observed	Expected	X^2	Probability
Non-tillered ..	495	504·5625		
Tillered ..	126	116·5775	0·8750	70·3640
Total ..	621	621·0000		

The observed figures agree to a 13 : 3 ratio indicating that one of the parents carries an inhibitory factor. Past experience with the strains shows that Co. 18 might carry the tillering character as well as the inhibitory factors as it exhibits a greater proclivity for tillering when induced by ratooning, insect damage or wider spacing.

The tillering habit appears to be economical also (Fig. 1). The earheads are bold and grain setting good. The tillers ranging from 1 to 5 grew vigorously and matured along with the main shoot. Apart from the difference in number of tillers there was no other perceptible variation amongst the tillered plants. The harvest can be completed in one lot as maturity is uniform unlike in the millets cumbu and ragi which also tiller freely.

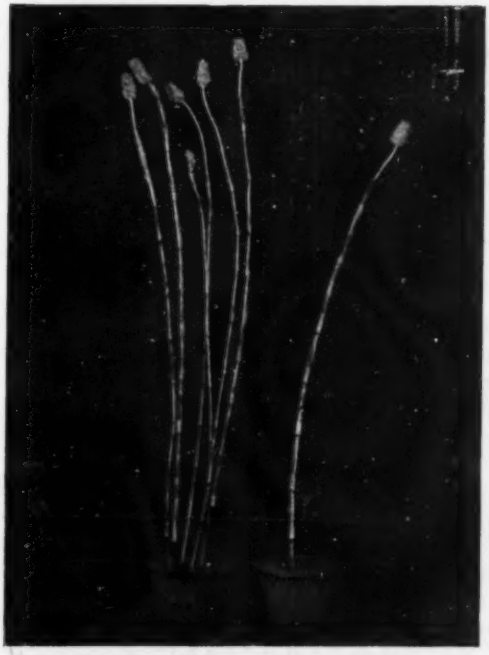


FIG. 1. Tillering and non-tillering conditions in Vellai Cholam. 1. A clump from F 2 of Co. 18 × K 2 with five tillers. 2. Single-stalked shoot of cholam K 2 (Co. 18 being similar to K 2 for tillering it is excluded from the photograph, *vide* text for details.)

The valuable guidance rendered by Sri. B. W. X. Ponnayya, Professor of Genetics, Agricultural College and Research Institute, Coimbatore and Sri. S. G. Ayyadurai, Millets and Pulses Specialist, in presenting the paper, is gratefully acknowledged.

Agricultural Res. Station, Kovilpatti, *July* 26, 1960. K. DIVAKARAN.

1. Ayyangar, Rangaswami, G. N. and Ponnayya, B. W. X., *Proc. Ind. Acad. Sci.*, 1939, 10 B (4), 237.
2. Goodal, S. V., *Mem. Dept. Agri. in India, Botany*, 1928, Ser. XIX, 247.
3. Hilson, G. R., *Agric. Jour. Ind.*, 1916, 2, 150.

PROPAGATION OF *ALTHEA ROSEA*, BENTH. AND HOOK. (HOLLY HOCK) BY AIR LAYERING WITH THE AID OF GROWTH REGULATORS

Althea rosea is an important ornamental shrub, which has so far been propagated by seed. It is difficult to raise plants true to type by seed propagation. Therefore, an attempt was made to propagate the plants by air layering with the aid of IBA, NAA and mixture of both.

Side shoots of 2–3 months old plants were selected for layering purpose. Indole butyric acid and Naphthalene acetic acid at concentrations of 4,000 p.p.m., 3,000 p.p.m. and 2,000 p.p.m. were used individually and in combination of both 1 mg. IBA + 1 mg. NAA with 1 gram of active carbon powder. The hormones were first dissolved in alcohol and mixed with carbon. The mixture was dried and powdered well. About 3 cm. wide bark was peeled off in the form of a ring. Upper cut end of the ring was smeared uniformly with different concentrations of hormones by means of camel-hair brush after moistening the ringed portion with water. Shoots treated were covered with damp soil containing leaf mould and tied firmly with Alkathene.

TABLE I

The effect of IBA, NAA and combination of both on rooting percentage, nature of rooting and average length of longest root in the air layer of Althea rosea

Sl. No.	Hormones in p.p.m.	Percentage of rooting	Nature of rooting	Average length of the longest in cm.
1	IBA			
(*a*)	4 000	100	S	5·4
(*b*)	3,000	100	P	9·7
(*c*)	2,000	100	P	7·5
2	NAA			
(*a*)	4.000	100	S	10·8
(*b*)	3,000	100	P	10·06
(*c*)	2,000	100	P	10·4
3	IBA+NAA + 1 gram A.C.	100	P	10·5
4	Control	30	N	..

Note: P=Profuse. S=Sparse. N=Negligible. A.C.=Active Carbon.

There were twelve shoots under each treatment. Gootees were examined for rooting at six days interval. Twenty-two days after actual treatment, gootees were cut-off from mother plant for final observations.

All the treatments with regulators proved advantageous and cent per cent success was achieved in gootees (*see* Fig. 1 and Table I).

FIGS. 1 *a–b*. Fig 1 (*a*). A gooteed plant of *Althea rosea*. Fig. 1. (*b*) Showing rooted twigs under each treatment with different kinds of hormones.

The lower concentrations of both hormones were found favourable in inducing roots. The higher concentrations were less effective. The lower concentrations induce roots as early as 14 days from the date of treatment.

Author is grateful to Shri B. Venkoba Rao, Principal, for his interest and providing facilities.

Division of Botany, D. S. LINGARAJ.
College of Agriculture, Hebbal,
Bangalore, *August* 16, 1960.

FIELD TRIALS WITH SOME INSECTICIDES FOR THE CONTROL OF SWEET POTATO WEEVIL

THE sweet potato weevil *Cylas formicarius* F. is one of the most destructive and widely distributed insect pests of sweet potatoes in India. Damage caused by it in Bihar alone sometimes extends up to 90% of the late-harvested crops. Recent experiments for the control of this pest with lindane, aldrin, dieldrin, endrin, DDT, parathion and calcium arsenate at Anakapalle (Andhra) yielded erratic results.[1] Subsequent trials with aldrin, dieldrin and lindane in the Madras State also proved inconclusive.[2] Only in Mysore State, dusting with BHC and spraying with parathion (Folidol) seemed to have afforded partial relief.[3] The comparative efficacy of BHC, aldrin, chlordane (all 5% dusts), and parathion (20% wettable) at a rate of one and two pounds (active ingredients) per acre, against *Cylas formicarius* F., was studied in a randomized field trial at Patna during 1957-58. The results are given in Table I.

TABLE I

Effectiveness of insecticides applied for the control of Cylas formicarius *F.*

Treatments	Rate of application per acre	Weight of tubers per plot in oz.		Percentage infestation	Effectiveness*
Infecticide	(pounds)	Healthy	Infested	%	%
BHC ..	1	230	23	9	74·4
BHC ..	2	223	20	8	77·7
Chlordane ..	1	298	25	8	72·2
Chlordane ..	2	194	29	13	67·7
Parathion ..	1	223	69	24	23·3
Parathion ..	2	250	51	17	32·2
Aldrin ..	1	294	22	7	75·5
Aldrin ..	2	399	12	3	86·6
Control ..	..	219	90	29	..

*By Abbott's formula.

Aldrin gave the best results. Average infestation in plots having 2 pounds of aldrin per acre was only 3% and the effectiveness of the treatment was rated at 86·6%. The yield was also highest—411 ounces per plot (82% higher than yield in control plots). In the plots having 1 pound aldrin per acre, the average percentage of infested tubers was 7 and the effectiveness of the treatment was 75·5%. BHC and chlordane were also effective, but parathion proved to be most ineffective of all the insecticides used.

No phytotoxic effects were evident in the plots treated with aldrin. The tubers from these plots did not exhibit any deterioration in taste or flavour.

Grateful thanks are due to Dr. Pushkarnath, Director, for his kind interest in the work.

Central Potato Research Institute, Simla, K. K. NIRULA.
K. N. CHHIBBER.
Potato Research Station, P.O. Sahay Nagar, Patna (Bihar), *August* 29, 1960.

1. *Annual Progress Report of the Tuber Crop Scheme in Andhra State, Anakapalle, for* 1954–55.
2. *Annual Progress Report of the Tuber Crop Scheme for* 1954–55 *in Madras State.*
3. *Final Report of the Scheme for Research on Tuber Crops for the Period* 1*st July* 1951 *to* 31*st March* 1955.

SHELL DISEASE IN *CRASSOSTREA GRYPHOIDES* (SCHLOTHEIM)

SHELL diseases have been prevalent in British, Dutch and French oysters. Cole and Waugh (1956) find that in case of British oysters, the disease commences with the dendritic white markings in the shell, usually in both valves. These markings are probably the results of infection by a fungus. The disease occurring in Dutch and French oysters is commonly referred to as 'maladie du pied', and here, it is in the form of greenish-brown patches and warts, leading to the serious loss of condition. When the disease reaches the muscle attachment, there is interference with the closing mechanism, resulting in death.

The occurrence of a shell disease does not appear to have been recorded in case of the back-water oyster, *C. gryphoides*. However, during the collections of *C. gryphoides* from a cultivated farm near Bombay for the study of some aspects of its biology, seven specimens were noted with shell disease. The interior of the shell of one oyster was strewn with greenish-brown patches and the muscle scar appeared disfigured (Fig. 1). The disease of this oyster, therefore, appears to resemble, 'maladie du pied', diagnosed by Giard (1894), Hornell (1910), Ranson (1936) and Cole (1950) in French and Dutch oysters.

In the case of five other oysters, a dark-green patch on the interior of the shell was noticed, but there was no marked disfiguration of the muscle scar or the interior of the shell as mentioned above (Fig. 2). It is likely that this may perhaps be the beginning of the oyster disease. In the case of the remaining specimen of oyster, the muscle scar was found blistered and the animal was almost detached from its shell. However, the interior of the shell was not disfigured by greenish-brown patches as above (Fig. 3).

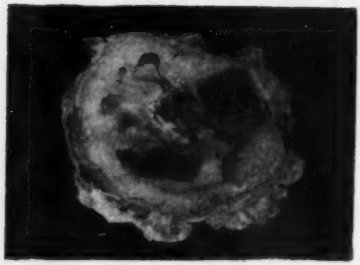


FIG. 1

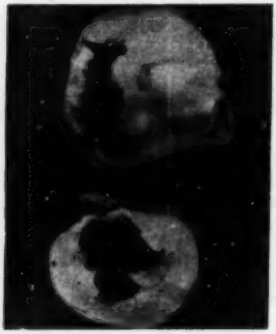


FIG. 2

FIG. 3

In all these specimens, the meat was watery, pale and brown in colour, giving the oyster unhealthy appearance.

Korringa's investigations have shown that shell disease spreads rapidly in hot summers. However, in case of *C. gryphoides* out of nearly three thousand specimens examined during a period of two years only seven were found affected, indicating thereby the absence of the spread of shell disease.

Department of Zoology, V. S. DURVE.
Institute of Science, D. V. BAL.
Bombay-1, *September* 22, 1960.

1. Cole, H. A., *Nature*, 1950, **166**, 19.
2. — and Waugh, G. D., *Ibid.*, 1956, **178**, 422.
*3. Giard, A., *C.R. Soc. Biol.*, 1894, **46**, 491.
4. Hornell, J., *Madras Fish. Bull.*, 1910, No. **4**, 1-31
*5. Korringa, P., *Cons. prem. Int. pour l'explor de la mer.*, Edinburg, 1949.
6. Ranson, G., *C.R. Soc. Biol*, 1936, **121**, 540.

* Not referred to in original.

OCCURRENCE OF *THOREA RAMOSISSIMA* BORY IN INDIA

THE genus *Thorea* Bory (Thoreaceæ, Nemalionales, Rhodophyta) comprises about 6 species all of them occurring in fast flowing freshwater streams. The type of genus is *Thorea ramosissima* Bory. The genus is known from Europe, America, Japan and some of the larger islands in the Indian Ocean (Fritsch, 1945; Kylin, 1956). This genus has not been reported from India so far. From India only some other species of freshwater genera of the Rhodophyceæ namely *Batrachospermum* and *Compsopogon* have been recorded.

The author while making algal collection, in a swiftly running stream Narkatia near Bareilly, in the last week of January, 1955, encountered the alga for the first time (Fig. 1). During subsequent years, i.e., 1956, 1957 and 1958, regular collections from the same spot have been made. The plants show fairly luxuriant growth and attain a length of two to three feet. *Compsopogon cæruleus* Mont. and a species of *Batrachospermum* were also collected from the same rivulet. During regular collections, however, it has been observed that *Batrachospermum* is the first to appear in December, it starts degenerating by February, whereas *Thorea ramosissima* appears last and continues a luxuriant growth even up to early March.

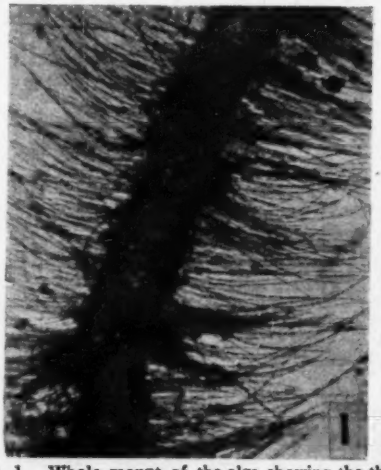


FIG. 1. Whole mount of the alga showing the thallus and the threads covering it, × 30.

The author is thankful to Dr. P. Bourrelly, Director, Museum National D' Histoire Naturelle, Laboratorie De Cryptogamie, Paris, for confirming the plant as *Thorea ramosissima* Bory, and to Dr. Bahadur Singh for going through the manuscript.

University Dept. of Botany, DALBIR SINGH.
Jaswant College,
Jodhpur, *August* 31, 1960.

1. Fritsch, F. E., *The Structure and Reproduction of the Algæ*, 1945, Vol. II, London.
2. Kylin, H., *Die Gattungen der Rhodophyceen, Glorups, Lund.*, 1956, p, 101.

REVIEWS

Reports on Progress in Physics, Vol. XXIII. Edited by A. C. Stickland. (The Physical Society, 1, Lowther Gardens, Prince Consort Road, London S.W. 7), 1960. Pp. 629. Price 63 *sh.*

The series of *Annual Reports on Progress in Physics* which the Physical Society, London, has been regularly publishing for the past nearly quarter of a century, have become an essential part of scientific literature in Physics. Nearly all colleges and centres of physical research possess these volumes, and each year they look forward to this annual addition to their libraries. A welcome departure was adopted in 1954 when the Society in addition to the publication of the bound volume also made available each article separately in paper covers at cheaper rates for wider use by individual workers interested in particular fields of study. Since the aims and objects of this publication as well as the general standard and quality of the articles in the annual issues are well known, we shall in this review of the latest issue Vol. XXIII, 1960, content ourselves with giving the titles of all the ten articles with their contributors and briefly indicate the importance of only some of them.

The first article is on "Optical properties of thin films" by O. S. Heavens (pp. 1-65). In this the author first discusses the optical behaviour of a surface layer (transition layer) of molecular dimensions as a problem in scattering, since the structure of such a film can be considered as aggregates of crystallites of variable size and orientation, and interspersed with different extents of voids. Multilayer films of several millimicrons thickness are treated from the electromagnetic theory, attributing to the layer a refractive index and (for absorbing material) an extinction coefficient. The article includes a discussion of interference filters, and some important applications of thin films in optics.

The second article is on "Group theory in solid state physics" by D. F. Johnston (pp. 66-153). The third is on "Photoelectric photometry" (pp. 154-75) by H. J. J. Braddick and the fourth article is on "Experimental analysis of the electronic structure of metals" (pp. 176-266) by A. B. Pippard.

In the fifth article on "New developments in interference spectroscopy" (pp. 267-312) P. Jacquinot gives a critical review of the developments that have taken place in this field during the last ten to fifteen years. The article describes in particular the new types of spectrometers which select the different wavelengths by the *amplitude* modulation, and by the *frequency* modulation.

The sixth article is on "Planetary nebulæ" by M. J. Seaton (pp. 313–54). Planetary nebulæ are clouds of ionized gas surrounding certain hot stars. They have dimensions of the order of a million solar radii. Seen through a telescope they appear as pale-green discs resembling the planets Uranus and Neptune. The spectrum of a planetary nebula shows a large number of emission lines (both allowed and forbidden) against a background continuum. The pale-green appearance is due to the strong emission (forbidden) lines λ 5007 and λ 4959 of doubly ionized oxygen, originally ascribed to 'nebulium'. In this article the observed spectroscopic data are interpreted in terms of the processes taking place in a low density ionized gas exposed to dilute ultra-violet radiation from the central star.

The seventh article is on "Band structure calculations in solids" (pp. 355-94) by L. Pincherle.

The study of capture of an orbital electron by the nucleus is of fundamental theoretical importance as it points to the influence of the atomic electrons on nuclear properties. The most frequently observed capture is that of a K-electron, but capture of an L-electron can also occur. Orbital electron capture manifests itself only in the form of emission of X-rays and Auger-electrons. The article "Orbital electron capture by the nucleus" (pp. 395-452) by R. Bouchez and P. Depommier reviews the subject both from the theoretical and the experimental aspects.

In the article on "Precision measurement in γ-ray spectroscopy" (pp. 453-543) the authors G. A. Bartholomew, J. W. Knowles and G. E. Lee-Whiting discuss in detail high precision γ-ray spectrometers based on each of the four categories: (*i*) coherent scattering or crystal diffraction: (*ii*) photoelectric effect; (*iii*) Compton effect and (*iv*) pair production.

The last article is "^{3}He induced reactions" by D. A. Bromley and E. Almqvist (pp. 544–629). On account of its high mass excess

(15·814 Mev.) and its high charge to mass ratio (2/3), the ^3He nuclide has come to be recognized as a very useful projectile in nuclear studies, and extensive publications have appeared in recent years dealing with ^3He induced reactions. The important results of investigations in this field have been summarized in this article. The report contains a comprehensive bibliography of papers covering about ten pages. The concluding part of the report containing suggested problems with low energy ^3He accelerators will be of particular value to research workers in the field.

A. S. G.

X-ray Spectrochemical Analysis. By L. S. Birks. (Interscience Publishers, Inc., New York), 1959. Pp. 137. Price $ 5.75.

This is the eleventh volume in the series of monographs on Analytical Chemistry and its Applications. The X-ray spectrochemical analysis is not a new field of interest, but the development of new instrumental technique during the past decade necessitated the publication of a new book on the subject. This book under review is therefore a welcome addition to our shelves. As stated in the preface, the author has made an effort "to bring the subject up-to-date for the scientist who is interested in X-ray spectrochemistry as a research tool and also to present the material in a way that will be useful to those persons who are only interested in knowing enough about the methods to be able to use it judiciously for routine analysis". Some of the future potentialities have also been pointed out.

After a simplified but very short chapter (in 3 pages) on fundamentals, the author has arranged the subject-matter on excitation of the X-ray spectra, the dispersion and dispersion geometry of practical systems, and the detection and measurement of the spectra in the next three chapters. Following these are described techniques for quantitative analysis and their applications. In the seventh chapter the most important recent advance on X-ray spectroscopy, *viz.*, the electron probe microanalyzer has been discussed in detail. This apparatus appears to have a great future because it can detect $\sim 10^{-13}$ to 10^{-14} gm. of an element or can perform chemical analysis on areas as small as 1 micron in diameter.

The general plan of the book was well conceived and has been written in a style to make the subject-matter readily comprehensible to the routine analysts and to newcomers. However, in a few places not very precise statements will be noticeable to a critical expert in the subject. Also, according to the reviewer, some discussion on X-ray absorption spectrography should have found some space in this book.

Though this book by Dr. Birks is not very comprehensive, it contains a considerable wealth of information on X-ray emission spectrography, provides useful suggestions to the worker and should prove to be a valuable addition to the literature of applied spectroscopy.

A. B. B.

Ultracentrifugation in Biochemistry. By Howard K. Schachman. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1959. Pp. 269. Price $ 8.80.

No technique has done more than ultracentrifugation to the fundamental physical chemistry of macromolecules, and in recent years, it has become increasingly applicable to small molecules as well. As a tool for the preparation and separation of proteins, viruses, and many other substances it is of great and growing importance. Moreover, the processes occurring in sedimentation are complex and fascinating and the experimenter has therefore to understand them in order to interpret correctly the phenomena they observe.

In the present monograph are set out experimental and theoretical aspects of ultracentrifugation. After a brief introduction highlighting some of the principal developments, in Section II under the title 'General Considerations' the subject is dealt with in general terms. Section III deals with developments of the experimental techniques in the field, such as improvements in the instrument cells, rotors, measurement and control of temperature and the various optical systems. The following three sections deal with the fundamental principles of the major divisions, namely, sedimentation velocity, transient states and sedimentation equilibrium.

The presentation adopted in the monograph is likely to appeal more to the physical chemist than the biochemist, although the latter will get a grasp of the theoretical aspects of the subject by studying it. Details about experimental set-up are absent. A bibliography is appended at the end.

A. J.

Viscoelasticity—Phenomenological Aspects. Edited by J. T. Bergen. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. x + 150. Price $ 6.00.

The importance of polymers in life and modern civilization cannot be overemphasized. Proteins and carbohydrates are natural polymers. Rubber, plastics, synthetic elastomers and fibres, and resins are all polymers whose uses reach into virtually every facet of our lives. Their industries have assumed enormous proportions in the modern age.

The increasing use of polymer materials in engineering, design, equipment and construction demands a proper understanding of their elastic properties, at least in the range of their applications and production. The problem of stress-strain relations in polymers is different from the ordinary elastic problem. The basic approach is not a molecular approach but a structural one. In the case of polymers it is not possible to generalise their viscoelastic properties, since the presence of entanglements, cross-links, or crystallites profoundly affect their mechanical behaviour. Above all the time factor enters in the mathematical analysis and the boundary conditions are limited by the history of the process.

One method of theoretical approach to the problem which will be fruitful is the phenomenological approach, that is to say, to consider the viscoelastic material as a continuum which is characterized by specific, fundamental parameters, and to describe the response of this continuum to stress or strain by a system of mathematical statements applicable to the theories of continuum mechanics, and then test the conclusions from the results of observation.

These theories are less familiar and especially in the case of non-linear viscoelastic theories they are still in the formative stage. In this context the publication of the monograph under review giving in the compass of a handy volume latest theories and views on this important subject will be welcomed by workers in this field.

The seven chapters of this book are the contents of the seven papers presented and discussed at a symposium on viscoelasticity which was held in April 1958, at the Research Development Centre of the Armstrong Cork Company, Lancaster, Pennsylvania. The Chapter headings and contributors are as follows: (1) Stress Analysis for Viscoelastic Bodies by E. H. Lee; (2) The Linear Viscoelastic Behaviour of Rubber-like Polymers and its Molecular Interpretation by R. S. Marvin; (3) Comparisons of Viscoelastic Behaviour in Seven Typical Polymer Systems by J. D. Ferry and K. Ninomiya; (4) The Behaviour of Certain Viscoelastic Materials in Laminar Shearing Motions by J. L. Ericksen; (5) Constitutive Equations for Classes of Deformations by R. S. Rivlin; (6) Stress Relaxation of Polymeric Material in Combined Torsion and Tension by J. T. Bergen; (7) The Normal Stress Effect in Polymer Solutions by H. Markovitz.

A. S. G.

Lead Isotopes in Geology. By R. D. Russell and R. M. Farquhar. (Interscience Publishers, Inc., New York), 1960. viii + 243, Appendices I to XII. Price $ 9.00.

The volume under review constitutes the first systematic attempt to bring together all the relevant data on the nature and geologic significance of isotopic abundances of common lead. The authors, Drs. Russell and Farquhar, have made original contributions to the subject and are hence eminently qualified to undertake such a compilation. Chapters I and II deal with the principles of lead isotopic method of dating and the techniques of determining lead isotopic abundances. Current ideas on the age of the earth, as deduced from lead isotopic data, are elucidated in Chapter III. The authors accept Patterson's value of 4,550 ± 70 m.y. for the age of the earth. The next Chapter relates to the principles of dating of galenas from their isotopic constitutions. Separate chapters have been devoted to anomalous lead, case histories, extension of Holmes-Houtermanns model (by Bate, Damon, Marshall and Russell) and lead-uranium-thorium methods of dating. Recent advances in the understanding of the significance of lead isotopic abundances have made it possible to decipher the geological history of a given region from a comprehensive study of lead isotopes. Such a study has been attempted for the regions of Sudbury and Thunder Bay, Canada and Broken Hill, Australia. The subject of rock lead, however, deserves a more extensive treatment than has been accorded to it in the present volume.

The twelve appendices, which appear at the end of the book, provide a complete list of lead isotopic analyses and thus constitute a valuable reference source.

The monograph is useful as a reference volume to researchers and post-graduate students interested in lead methods of dating.

U. A. N.

Proceedings of the Symposium on the Nature of Coal. (Central Fuel Research Institute, Jealgora, Bihar), 1959. Pp. 321.

The Central Fuel Research Institute, Jealgora, in collaboration with the Institute of Fuel (Indian Section) organised a symposium on the nature of coal and the volume under review consists of the texts of 40 papers presented at the symposium and the discussions thereupon. The symposium was organised in six Sessions, on the following topics: Origin and systematics of coal, Petrographic and X-ray studies on coal, Coal constitution—Physical methods, Coal constitution—Chemical methods and Physico-chemical properties of coal. It is interesting to note that commonwealth countries, U.S.S.R., Japan, etc., contributed about half the number of papers presented at the symposium.

The large volume of research that has been done on coal utilisation stands in marked contrast to the paucity of data on the nature of coal, its physical and chemical constitution and ultrafine structure. The present symposium highlights the recent advances made in India and other parts of the world on the nature of coal by the application of techniques like X-rays, electron microscopy, petrographic studies, etc., and suggests avenues of research which can be fruitfully explored.

The volume is a welcome addition to all research workers interested in fundamental research on coal.

C. MAHADEVAN.

The Chemistry and Biology of Sialic Acids and Related Substances. By A. Gottschalk. (Cambridge University Press, London N.W. 1), 1960. Pp. ix + 115. Price 22 *sh.* 6 *d.*

A great deal of interest has been evinced in recent years on the chemistry and biology of sialic acids since these compounds are known to provide the groupings which attract and bind influenza particles to the surface of host cells preliminary to the actual process of infection. The sialic acids are found widely distributed in animal tissues, glandular secretion and blood serum and form constituents of mucoproteins, mucolipids and lipoprotein-carbohydrate complexes.

After a historical introduction, Dr. Gottschalk has given an account of the physical and chemical properties of sialic acids as also their preparation from various natural materials, their quantitative assay and identification by specific colour reactions. He has then dealt with their distribution in tissues and body fluids under physiological as well as pathological conditions. Further, there is a good account of Muramic acid which is the counterpart of sialic acid in bacteria and which appears to be an integral component of their basal cell-wall structure.

The author gives further in this monograph a well-balanced description of the molecular structures of sialic acids and related compounds as also an account of their known biological functions. As stated by him "it is the biological flavour which makes the cold beauty of the chemical structure displayed in this book so attractive" and it is to be hoped that a study of its contents will stimulate further research work in this new field of biochemistry.

P. S. SARMA.

Sector-Focussed Cyclotrons—Proceedings of an Informal Conference held in Sea Island, Georgia, February 2-4, 1959. Edited by F. T. Howard. (Publication 656, National Academy of Sciences—National Research Council, Washington D.C.), 1959. Pp. 291. Price $ 2.50.

The first cyclotron was built by E. O. Lawrence at Berkeley, and as a particle accelerator this device held supremacy for many years. Several artifices were introduced for obtaining greater and greater energy ranges. Relativistic range of energies were made accessible through frequency modulation. Another recent development is the use of sector focusing, to retain isochronism in the face of relativistic increase in particle mass. The basic difficulty with a cyclotron is, that the magnetic field should decrease with increasing radius to provide focusing, but should increase with radius to compensate for the relativistic mass increase of the particles during acceleration. L. H. Thomas first showed that this difficulty can be resolved by making the field to have azimuthal variations, which provide additional focusing to compensate for the defocusing. These azimuthal variations may be sinusoidal or square wave or radial or spiral. In the design, several factors enter such as choice of field shape representation, orbit calculations, adjustment of the field for the resonance condition to prevent phase slip, beam quality and design of radio-frequency system.

The forty odd papers presented during the Proceedings have fallen under six Sessions: Session I: Orbit Calculations and Magnetic Field Design; Session II: Realisation of Required Field Configurations and Model Magnet Work; Session III: Radio-frequency Systems; Session IV: Beam Quality; Session V: Beam Extraction;

Session VI : External Focusing Systems, Instrumentation, Operational Experience, and Summary of Outstanding Problems.

The Proceedings represent a considerable body of cyclotron operation experience, theory, design and testing work, informally presented, and is of much interest to experimental nuclear physicists.

A. J.

Chemical Analysis of Resin-Based Coating Materials. Edited by C. P. A. Kappelmeier. (Interscience Publishers, Inc., New York), 1959. Pp. 630. Price $ 19.50.

Coating materials like varnishes and paints, compounded as they are with a base, a vehicle, a pigment and a thinner, are complex mixtures of inorganic and organic substances. With the increasing application of coating materials for industrial, protective and decorative purposes, and with the availability of many varieties of raw materials like oils, resins —natural and synthetic—and thinners, standardization and quality control of the raw materials and finished products demand a wide knowledge of analytical chemistry. The book under review supplies this demand. It is a valuable publication of great practical utility as it contains details of all the important methods used so far for the assay and analysis of coating materials. The editor, C. P. A. Kappelmeier, who had devoted a whole lifetime for the development of the paint industry, and twenty-six other specialists, have contributed the twenty-one chapters of the book. The subject-matter has been classified under three parts entitled : (I) Analysis of oil-based coating materials, (II) Analysis of lacquers and (III) Selected chapters in the analysis of coating materials. Part I contains methods for the separation of pigments and vehicles, as well as methods for the analysis of vehicles, oil-varnishes, resin-based coating materials, styrene-modified oils and alkyd resins, solvents and thinners, and latex paints. Part II deals with the analytical procedures for lacquers and resins. Application of infra-red spectrophotometry, steam distillation and complexometric titration and methods for the analysis of fatty acids, halogen compounds, silicone resins, polyester resins and isocyanate coating materials are included in Part III. The classical gravimetric and volumetric methods as well as the modern physical methods like spectrophotometry, polarography and chromatography find application in this field. The material presented is fully documented and indexed, author- and subject-wise. A comprehensive list of items required to equip a laboratory for the analysis of coating materials is given as an appendix. It was unfortunate that the editor C. P. A. Kappelmeier did not live to witness the warm reception the book would receive at the hands of all those interested in the science and technology of coating materials.

B. H. Iyer.

Principles of Dairy Science. By Ernest Vanstone and Bristow M. Dougall. (Cleaver-Hume Press Ltd., London W. 8), 1960. Pp. 238. Price 25 *sh.*

The scientific principles of dairying in relation to the nutrition of the animals, chemistry and bacteriology of milk and their application to processing for the fluid market and manufacture of milk products, legal aspects of processing and quality control, methods of quality control, water-supplies and sanitizers for the dairies, are covered in broad outline in the 21 chapters of the book. The text is presented in a lucid and logical sequence. Though there are a number of books on the subject, this new approach adopted by the authors in covering the field from a wider angle will appeal both to the students and busy executives as a source book for easy reference. The book has been clearly printed and well illustrated.

N. N. Dastur.

Advances in Organic Chemistry—Methods and Results, Vol. I. Edited by R. A. Raphael, E. C. Taylor and H. Wynberg. (Interscience Publishers, New York), 1960. Pp. ix + 387. Price $ 12.00.

In *Advances in Organic Chemistry : Methods and Results,* Volume I, has been reviewed (1) The Kolbe Electrolytic Synthesis ; (2) Polyphosphoric Acid as a Reagent in Organic Chemistry ; (3) Wittig Reaction ; (4) Hydroxylation Methods ; (5) The Selective Degradation of Proteins ; (6) Optical Rotatory Dispersion and the Study of Organic Structures. As is evident the subjects comprise of methods used in synthetic and degradative studies, reagents with versatile application, and application of a very recent technique leading to precise and valuable information about conformation and configuration of organic molecules. References to latest developments and also to important unpublished results achieved in the field are of great advantage to the research workers. The introduction of "Experimental" section in different chapters is also very useful. The Editorial

Board should be congratulated on their success in getting the experts to write the different chapters.

D. K. BANERJEE.

Ticks, a Monograph of the Ixodoidea, Part V. By Don R. Arthur. (Cambridge University Press), 1960. Pp. xviii + 250. Price 60 *sh.* net.

The present volume forms the fifth part of a comprehensive work on the morphology, taxonomy, distribution, ecology and biology of ticks in relation to disease in man and other animals. The work itself was planned by Prof. G. H. F. Nuttall in the early years of this century when ticks were recognized as important carriers of *Piroplasma* and other parasites and the first part was published over 50 years ago. Dr. Arthur's book deals with five genera of which *Dermacentor* is the most important. Planned and executed with perfect care, the present part forms a fitting addition to the series on Ixodoidea and an invaluable reference work to all students of the group and also to parasitologists.

B. R. S.

Aedes aegypti. By Sir R. Christophers. (Cambridge University Press), 1960. Pp. xii + 730. Price 75 *sh.* net.

Aedes ægypti is not only the celebrated yellow fever mosquito but also the insect most extensively used all over the world for research studies bearing on many general problems of the physiology and genetics of insects. Complete information on all aspects of the species is therefore not only desirable but also vital, wherever tropical diseases are being studied. Sir R. Christophers' work fills the need admirably. In virtue of his association with research on the mosquito for over 60 years, Sir Rickard has a comprehensive knowledge of the organism equalled by none. There is probably no work extant on the animal which Sir Rickard is not acquainted with and none of importance which he has not referred to in the preparation of this work, which will remain a classic for a long time. Every aspect of the mosquito is dealt with—systematics, structure, life-history, behaviour and physiology. Additional information on other mosquitoes is also provided and the work is an encyclopædia of information on the mosquito as a whole and *Aedes* in particular.

B. R. S.

Jute in India. By B. C. Kundu, K. C. Bas and P. B. Sarkar. (Published by the Indi Central Jute Committee, Calcutta. A Mono graph), 1959. Pp. 395. 74 illustrations and charts and maps. Price Rs. 30.

This monograph is presented to the reader three sections, with useful bibliography. Se tion I deals with the botanical, breeding a other aspects of jute crop. Jute is second cotton amongst world's textiles. Of the species known only *Corochorus capsularis* a *C. olitorius* are fibre producing. Excepting few African, all Indian species are branchin The commercial jute being a bast fibre, anatomy, physiology and the conditions deter mining the quality of the commercial fibre ha been studied in detail.

Section II deals with the economics and analyses factors influencing the jute market. Near 80% of world's jute is produced in India an Pakistan and most world demand is met mainl by India. Brazil and Formosa also produce som jute. The most important export, apart fro raw jute, is in burlap mainly to U.S.A. Serio growing competition is from European market exporting more highly finished burlap suite to the needs of U.S.A. To offset possible loss of markets exploration of new markets, develop ing internal ones, research to produce bette finished products and to replace such importe articles are suggested.

Section III deals with the several technological aspects of jute fibre, interesting X-ray an chemical studies, processing, spinning, weavin and finishing. Species whose fibres are used a jute substitutes, those used in blending with jute numerous possible uses of jute and other aspect are also dealt with. Though in many respect the technology is similar to that of cotton, i others it differs and creates new problems.

N. KRISHNASWAMY.

Cryogenics—An International Journal of Low Temperature Engineering and Research Vol. I, No. 1, September 1960. Edited by K. Mendelssohn, R. B. Scott and L. Weil.

There is a need for a separate cryogeni Journal, especially on the engineering side, a the subject of cryogenic technology has in recen years advanced beyond the narrow confines o its applications to large-scale liquefaction an separation of gases only. With the increasing use of low temperature techniques in such widely different fields as liquid propellant bubble chambers, physics of the solid state

chemistry of free radicals, etc., the theoretical and engineering aspects of low temperature studies have come to occupy a position of importance in modern research. Hence this Journal *Cryogenics* will be widely welcomed by workers in this field.

This is a Quarterly Journal published by Heywood and Company Ltd., and edited by a Board consisting of K. Mendelssohn (Great Britain), R. B. Scott (U.S.A.) and L. Weil (France). The language of the Journal is English but the Abstracts of the original papers are printed in the four languages, English, French, German and Russian.

The first issue, Vol. I, No. 1, September 1960, is of 58 pages and contains a review article "Cooling by Adiabatic Demagnetization of Nuclear Spins" by N. Kurti, nine original contributions of about 4 pages each, covering different aspects of low temperature engineering and research, two letters, and two book reviews. In addition there is a bibliography which is a compilation giving the titles and authors of about a hundred papers on low temperature physics and engineering published in various journals during the period January-May 1960.

The annual subscription (4 issues) is £ 5, or $ 15.00 or N.fr. 90. The Journal is published by Heywood and Co., Ltd., Scientific Publications Department, Carlton House, Great Queen Street, London W.C. 2, England.

Books Received

Proceedings of the Centenary and Bicentenary Congress of Biology, Singapore, 1958. Edited by R. D. Purchon. (University of Malaya Press, Singapore), 1960. Pp. 333. Price $ 13.50.

Introduction to Physical Chemistry (Vol. III, Advanced). By S. N. Mukherjee. (Art Union, 80/15, Grey Street, Calcutta-6), 1960. Pp. ix + 832. Price Rs. 25·00.

Fourier Analysis and Generalised Functions (*Students Edition*). By Light Hill. (Cambridge University Press, London N.W. 1), 1960. Pp. viii + 79. Price 10 *sh.* 6 d.

The Major Achievements of Science, Vols. I and II. By A. E. E. Mackenzie. (Cambridge University Press, London N.W. 1), 1960. Pp. xvi + 368. Price 30 *sh.*; Pp. xi + 195. Price 17 *sh.* 6 d.

Cotton in India—A Monograph, Vol. II. By R. H. Dastur, R. D. Asana *et al.* (The Indian Central Cotton Committee, P.B. No. 1002, Bombay-1), 1960. Pp. viii + 339. Price Rs. 30·00.

Introduction to Submolecular Biology. By Albert Szent-Gyorgyi. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. 135. Price $ 5.00.

Fluid Mechanics Through Worked Examples. By D. R. L. Smith. J. Houghton. (Cleaver Hume Press Ltd., 31, Wrights Lane, Kensington, London, W. 8), 1960. Pp. 344. Price 28 *sh.*

Harker's Petrology for Students. (Eighth Edition Revised.) By C. E. Tilley, S. R. Nockolds and M. Black. (Cambridge University Press, London N.W. 1), 1960. Pp. 283. Price 15 *sh.*

Physical Chemistry of Surfaces. By Arthur W. Adamson. (Interscience Publishers, N.Y.), 1960. Pp. xiv + 629. Price $ 12.75.

Lectures in Theoretical Physics, Vol. II. Edited by Wesley E. Brittin and B. W. Downs. (Interscience Publishers, N.Y.), 1960. Pp. vii + 483. Price $ 9.00.

Illustrated Genera of Wood Decay Fungi. By Charles L. Fergus. (Burgess Pub., Co., 426, South Sixth Street, Minneapolis-15, Minnesota), 1960. Pp. vi + 132. Price $ 4.00.

Illustrated Genera of Imperfect Fungi. By H. L. Barnett. (Burgess Pub., Co., 426, South Sixth Street, Minneapolis-15, Minnesota), 1960. Pp. iii + 225. Price $ 4.50.

Encyclopedia of Chemical Technology. Edited by Raymond E. Kirk and Donald F. Othmer. Second Supplement Volume, edited by Anthony Stonden. (Interscience Encyclopedia, Inc., New York-1, N.Y.), 1960. Pp. xv + 970. Price $ 25.00.

Symposium on Monsoons of the World—New Delhi, 19-21, *February* 1958. Edited by S. Basu, K. R. Ramanathan, P. R. Pisharoty and U. K. Bose. (The Manager of Publications, Civil Lines, Delhi), 1960. Pp. x + 270. Price Rs. 12·00.

Laboratory Handbook of Toxic Agents. Edited by C. H. Gray. (The Royal Institute of Chemistry, 30, Russell Square, London W.C. 1), 1960. Pp. viii + 170. Price 20 *sh.*

SCIENCE NOTES AND NEWS

Incidence of Parasitism and Mortality in the Pupae of *Coccinella septempunctata* (Linn.)

Joginder Lall Nayar, School of Entomology, St. John's College, Agra, writes: More than a thousand pupæ of *Coccinella septempunctata* (Linn.) were collected from the 'Brinjal' fields at Agra for the study of *Corpus luteum* formation in the said beetle. While rearing these at 84° F. and 40-45% R.H., it was observed that the total death of pupæ amounted to 62·4%, out of which 50·7% were parasitised by the *Tetrastichus* sp. and 11·7% died due to other unknown reasons. This parasitism of the *Tetrastichus* sp. causing the destruction of the pupæ of the predacious beetle is of great economic importance.

Award of Research Degrees

Madras University has awarded the Ph.D. Degree in Biochemistry to Shri S. Venkat Rao for his thesis entitled "Effect of Insect Infestation on the Chemical Composition and Nutritive Value of Foodgrains".

Andhra University has awarded the D.Sc. Degree in Physics to Shri M. S. V. Gopala Rao for his thesis entitled "Studies on the Spread F Irregularities in the Ionosphere" and the Ph.D. Degree in Physics to Shri S. Ramamurty for his thesis entitled "The Application of the Theory of Molecular Orbitals to Certain Organic Molecules".

Utkal University has awarded the Ph.D. Degree in Mathematics to Shri Sibaprasad Misra for his thesis entitled "A Study of the Theory of Elementary Particles".

Symposium on 'Plant Embryology'

Under the auspices of the C.S.I.R. Biological Research Committee, a symposium on "Plant Embryology" was held at the University of Delhi from November 11–14, 1960. Professor P. Maheshwari, Professor of Botany at the University, was the convener of the symposium.

The symposium was attended by leading plant embryologists of the country and a number of young research workers. Thirty papers covering a wide ground were presented and discussed at the symposium. The following list gives the titles of some of the papers read: (1) Embryology of *Quinchamalium chilense* Lam., (2) Embryological studies in the Commelinaceæ, (3) Embryological studies in the Loasaceæ with special reference to endosperm haustoria, (4) Embryological studies in relation to interspecific hybridization in jute, (5) *In vitro* studies on cotton ovules, (6) Intraovarian pollination in *Eschscholzia californica* Chem. and *Papaver rhœas* L., (7) Embryology of *Pœonia* with a discussion on its systematic position, (8) The embryo of monocotyledons: a working hypothesis from a new approach, (9) The formation of male yametes in the pollen tubes of certain crop plants, (10) Megasporogenesis in duplication and deficiency heterozygotes of *Oenothera blandina*.

There was also a discussion on "Teaching and research in plant embryology". Prof. P. Maheshwari suggested that a book on the "Comparative embryology of angiosperms" on the lines of Schnarf's "Vergleichende Embryologie der Angiospermen" be written as a joint undertaking by various authorities in India and abroad.—I. K. VASIL.

European Federation of Corrosion Annual Report for 1959

The Annual Report provides specialists with valuable information on the technical work on corrosion which has been carried out in Europe, with particulars of addresses and publications, research projects and papers read at meetings. The report can be ordered from the General Secretariat of the European Federation of Corrosion, Buro Frankfurt (Main), Postfach 7746. The price to members is DM 15 and to non-members DM 30.

Microbiology Congress to Meet at Montreal

The Eighth International Congress for Microbiology will be held at Montreal, Canada, from August 19 to 25, 1962, under the auspices of the Canadian Society of Microbiologists. There will be five Sections: Structure and Function; Agricultural Microbiology; Industrial Microbiology; Medical and Veterinary Microbiology; and Virology. Two or more symposia are being planned for each Section. All speakers at the symposia will be especially invited. There will be sessions for contributed papers in all Sections.

Enquiries should be made to Dr. N. E. Gibbons, Eighth International Congress for Microbiology, National Research Council, Ottawa-2, Canada.

United Nations Conference on New Sources of Energy

The United Nations Conference on New Sources of Energy, which will examine practical problems and experience in the utilization

of solar energy, wind power and geothermal energy, will be held in Italy, probably in Rome, from 21 to 31 August, 1961.

The Conference aims at bringing together experts in these fields as well as those interested in energy development in general, to provide participants with up-to-date information on progress achieved and to facilitate an exchange of views and experience relating to practical problems, potentialities and limitations in utilizing these three sources of energy, especially in those areas lacking conventional energy sources or facing high energy costs.

The Conference will focus attention on applications rather than on the discussion of scientific principles and basic research, giving prominence to lines of action which have already led, or are about to lead, to commercial energy applications. Theoretical studies will be discussed only if they appear to be closely related to practical developments.

Requests for further information on the Conference should be addressed to: Executive Secretary, United Nations Conference on New Sources of Energy, United Nations, New York.

Golden Jubilee Research Volume of the Indian Institute of Science, Bangalore

The Indian Institute of Science, Bangalore, which observed 1959-60 as the Golden Jubilee Year, has brought out a Research Volume to mark the occasion. The papers in this volume have been contributed by the staff and students of the Institute. The 35 papers by 65 authors from 12 Departments of the Institute, cover a wide range of subjects in pure and applied sciences and engineering. These papers embodying, as they do, the results of recent investigations on diverse problems in chemistry, physics, applied mathematics, biochemistry, microbiology, nutrition, metallurgy, and different branches of engineering, will interest all research workers engaged in similar problems. The volume-which has been brought out in good print on heavy-weight paper, will be a useful addition to current scientific literature in the libraries of all research institutions.

De novo Origin of the Nuclear Membrane

The behaviour of the nuclear membrane in prophase and telophase is one of the most attractive features of mitosis for the electron microscopist and cytologist. The nuclear membrane or envelope is formed either by a coalescence of vesicles derived from the endoplasmic reticulum at the chromosome surface, or, as in the case of the onion cells, by slender lamellar units of the endoplasmic reticulum draping themselves around the chromosomes at the poles in telophase. W. Bernhard has recently posed an intriguing question regarding the possibility of a *de novo* origin for the nuclear membrane.

In a problem like this, the selection of proper research material is perhaps more important than formulation of the original proposition. In such material, the number of cells undergoing mitosis should be unusually high, and the cells should not contain much endoplasmic reticulum and relatively few mitochondria. Electron microscope studies for an entirely different problem revealed that fœtal liver (human and rat) is an excellent tissue for a number of cytological problems. At certain stages of development, the actively proliferating erythroblastic cells may outnumber the hepatic cells and even deform them by encroachment. In the youngest erythroblasts, fixed with buffered osmic acid, the sparse slender profiles of endoplasmic reticulum disappear gradually by fragmentation into small vesicles. Basophilic erythroblasts (normoblasts), which are characterized by an abundance of ribonucleoprotein particles and a small volume of endoplasmic reticulum or an involution of it, are mitotically quite active.

During prophase the nuclear membrane leaves the surface of the contracting chromatin, fragments and migrates towards the cell periphery. It is apparently metabolized after further fragmentation into vesicles. Although this lamellar structure may persist into the telophase stage, it is not related to the reconstitution of the new nuclear membrane.

Reconstitution of the nuclear membrane occurs first, multicentrically, around the periphery of the daughter cell chromosomal mass farthest away from the interzonal spindle fibres. Examples of aberrant chromosomal masses and differential mitosis further emphasize that remnants of lamellar endoplasmic reticulum are not required for the formation of the nuclear membrane in erythroblasts.

This evidence for the *de novo* origin of the nuclear membrane assigns to the chromosomal mass a much more important role in its formation than has been possible in previous electron microscope studies because basophilic erythroblasts are remarkably free from lamellar and vesicular endoplasmic reticulum. This interpretation is in keeping with light microscope studies showing that the nuclear membrane is first formed in telophase by the coalescence of membranes from the cytoplasmic surface of each of the chromosomal vesicles. Hence, the nuclear membrane stands in a direct genetic relation to the chromosomal parts, and in the case of basophilic erythroblasts, it would be

actively involved in the nucleo-crytoplasmic exchange of basophilic material—(*Nature*, 1960, 188, 239).

Electron Behaviour in Alloys

The problem of distribution of electrons in solid alloys consisting of one metal dissolved in another has attracted the attention of scientists in recent years. It has become increasingly clear that a proper understanding of the structure of alloys on an atomic scale is essential for the production of stronger materials on any but an empirical basis. The interactions between atoms in metallic solid solution can best be studied by the nuclear magnetic resonance method, where the resonance peak is profoundly modified by changes in the electron distribution round the solute atom. The application of this method has thrown new light on this problem. By observing the effect of alloying on the nuclear resonance of copper, T. J. Rowland of the Metals Research Laboratories of the Union Carbide Metals Company, has been able to determine how closely these extra electrons are grouped around the solute atoms. Observations show that the resonance amplitude of copper undergoes a sharp reduction upon alloying. Further, its dependence on the valency and size of the solute atom leads to the conclusion that the dominant source of the electric field gradients surrounding the solute atoms is the redistribution of the conduction electrons. Calculations based on new theoretical consideration have shown that the actual distribution of the electrons is as a diffuse cloud around the solute atoms. The charge density in the cloud decreases inversely as the cube of the distance from the solute atom rather than exponentially, and thus its effects are of longer range than had been supposed. It may be pointed out that earlier workers have often confused these electronic effects with "local strains" that also happen to decrease as the reciprocal cube of the distance from the solute atoms.

Visual Observations of Superconductivity Effects

An experimental technique developed in the G.E. Research Laboratory, Schenectady, makes it possible to observe visually the transformations which take place in a superconducting material between the normal and the superconducting states. The method is based on two well-known facts connected with the phenomenon of superconductivity, namely, (1) a sufficiently strong magnetic field can change a material from the superconducting state to the normal state; and (2) so long as the material remains superconductive it is a perfect magnetic insulator.

In the experiment, the specimen to be observed is prepared in the form of a very thin flat disc. On top of this is placed a plate of a special cerium phosphate glass about 1/100" thick. When magnetized this plate has the property of rotating the plane of polarized light. A polarized beam of monochromatic light is made to fall on the glass, and the reflected light is viewed through a polarizing filter which can be rotated to any desired angle. The specimen material is cooled in liquid helium to a temperature of 1·5° K, when it becomes superconducting. But it can be changed back and forth between superconducting and normal states by varying a magnetic field. At certain magnetic field strengths the specimen is in the intermediate state with portions of it normal and portions superconducting.

Since the superconducting areas shield the portions of the glass plate directly above them from the magnetic field, these parts of the glass are not magnetized, whereas portions of glass directly above the normal areas, being not shielded, are magnetized. The magnetized areas of the glass rotate the plane of polarized light they reflect, while the shielded areas do not. By suitably adjusting the polarizing filter through which the reflected light is observed, the magnetized parts can be made to appear dark and the unmagnetized parts bright, or *vice versa*. Since the pattern of light and dark corresponds exactly to the pattern of superconducting and normal phases of the material, changes in the state of the sample can thus be visually observed or photographed—(*J. Frank. Inst.*, 1960, 270, 250).

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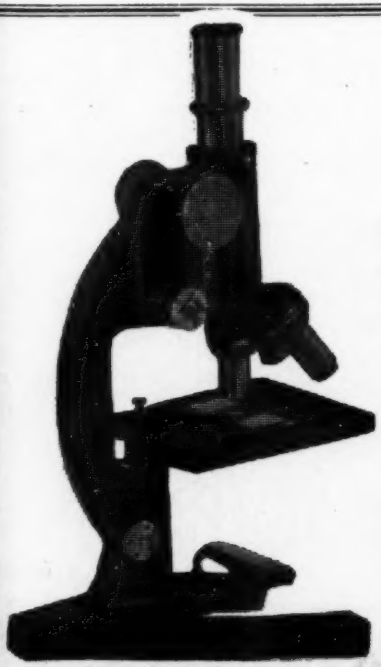

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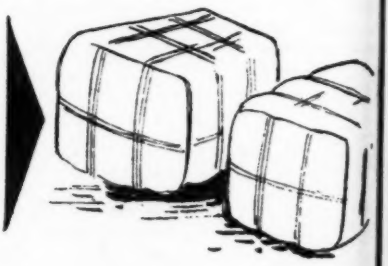

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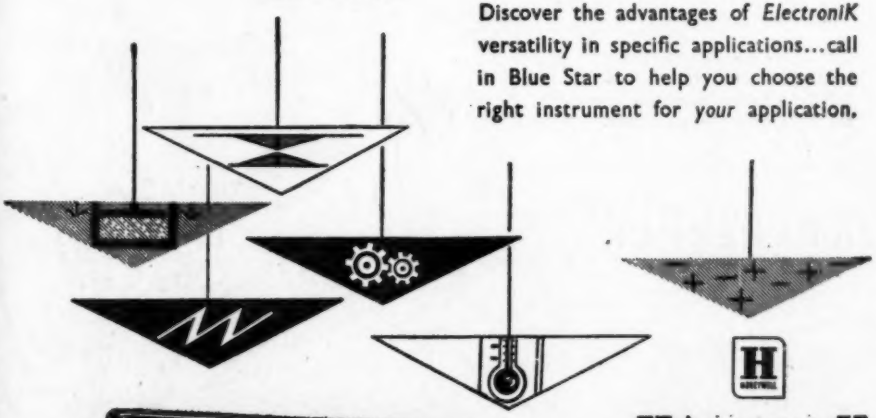

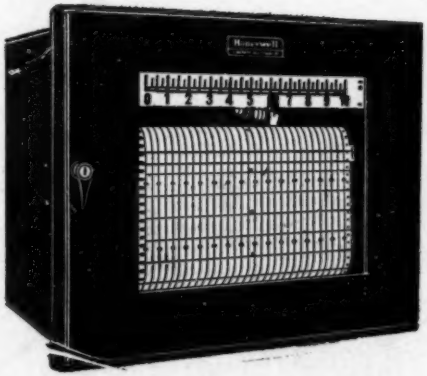

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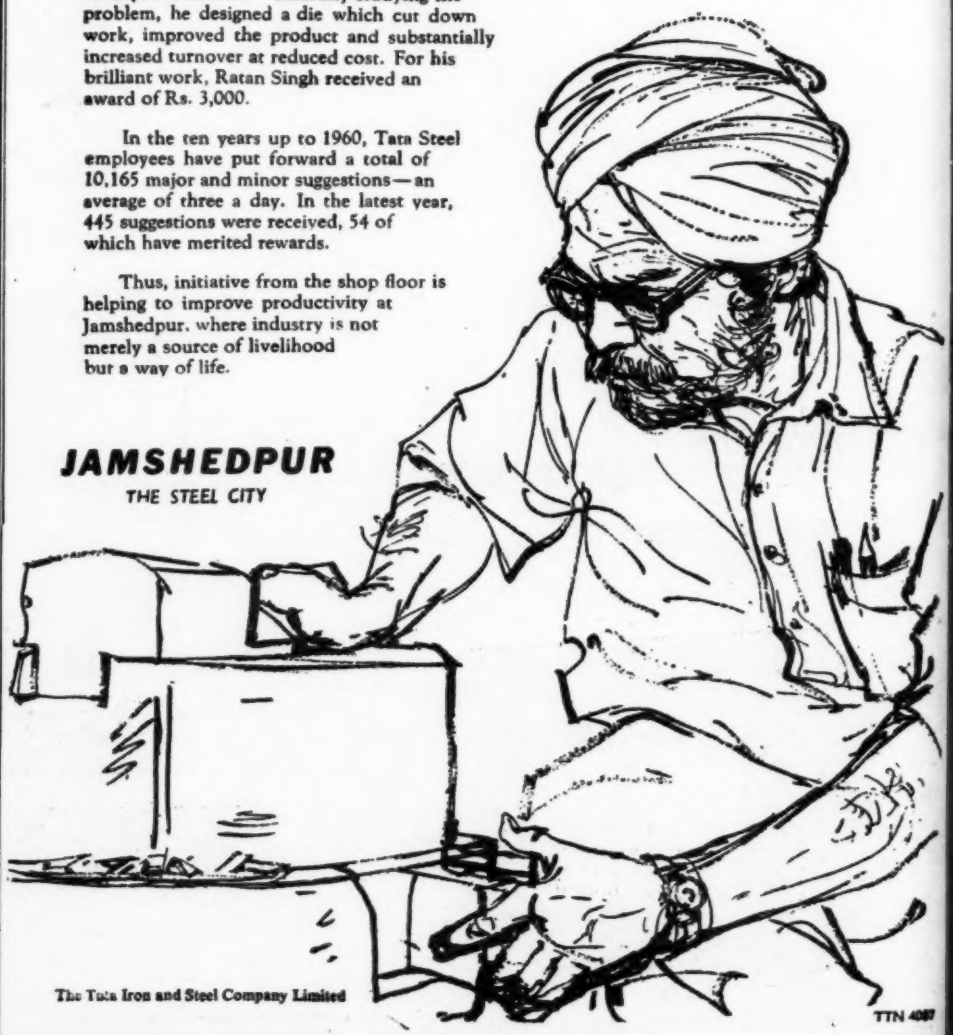

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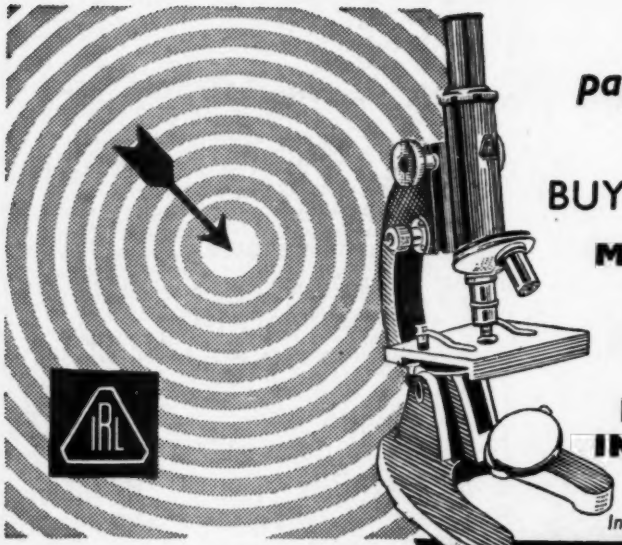

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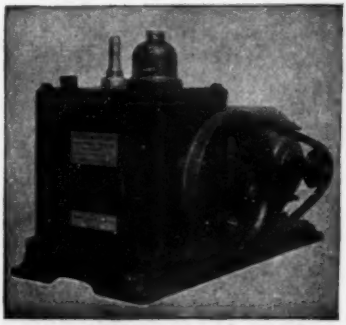

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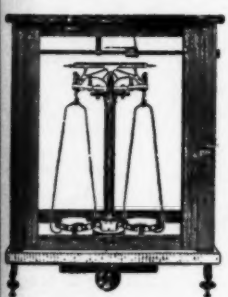

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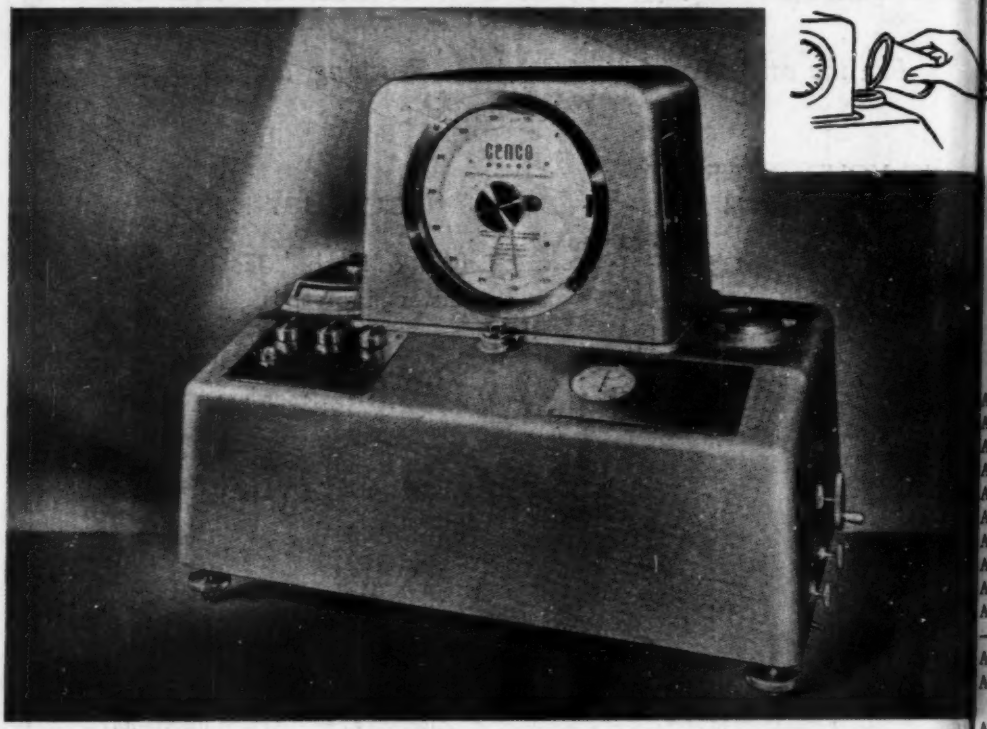

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